A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

AUGUST, 1940.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

2292. Discussion on the isotopic weight of C^{12}. J. MATTAUCH. *Phys. Rev.*, **57,** *pp.* 1155–1159, *June* 15, 1940.—The precision measurements of the masses of the 3 substandards, especially that of C^{12}, by different observers show a slight discrepancy well outside the probable error. The masses of all isotopes determined by the doublet method depend more or less on the masses of the substandards. Therefore Aston has expressed anxiety that some agreement should be reached on the isotopic weight of C^{12} to enable a satisfactory table to be adopted. In the present paper some of Aston's objections and criticisms are discussed in some detail as well as the checks which each author has to offer for his measurement of the principal doublet in question. At the end of the paper are given the masses of the 3 substandards H^1, D^2, C^{12} as well as the mass of N^{14} which are thought to be the most reliable at present. AUTHOR.

2293. The fabric theory of protein structure. D. WRINCH. *Phil. Mag.*, **30,** *pp.* 64–67, *July*, 1940.

2294. Electron diffraction investigation of the molecular structure of $TeCl_4$. D. P. STEVENSON AND V. SCHOMAKER. *Am. Chem. Soc., J.*, **62,** *pp.* 1267–1270, *May*, 1940.—Measurements for gaseous $TeCl_4$ lead to the values 2·33 ± 0·02 Å for the average Te-Cl distance, 3·37 ± 0·06 Å for the main Cl-Cl distance, and 93 ± 3° for the corresponding main bond angle. The radial distribution curve is compatible with models having equal or nearly equal Te-Cl distances, about 4 bond angles at 93°, and not more than 1 or 2 bond angles at any other value. This gives a distorted trigonal bipyramidal configuration with the unshared pair in one of the equatorial positions. N. M. B.

2295. Molecular structure of SO_2. V. SCHOMAKER AND D. P. STEVENSON. *Am. Chem. Soc., J.*, **62,** *pp.* 1270–1272, *May*, 1940.—From an electron diffraction investigation the S-O distance is found to be $1{\cdot}43_3 \pm 0{\cdot}01$ Å. Theoretical intensity curves lead to a bond angle O-S-O $= 120 \pm 5°$, in good agreement with the value 121 ± 5° derived from the bond distance and the entropy. N. M. B.

2296. Molecular size distribution in ethylene oxide polymers. P. J. FLORY. *Am. Chem. Soc., J.*, **62,** *pp.* 1561–1565, *June*, 1940.—It has been shown that in a polymer, formed exclusively by the addition of monomers to a fixed number of polymer molecules, the numbers of species of various sizes are represented by Poisson's distribution law. Equations representing weight fraction distributions have been derived, and the calculated percentage weight of various species in several polymers having average sizes of 6 to 500 units are shown graphically.

See also Abstracts 2420, 2459, 2461.

COLLOIDS.

✱2297. The measurement of heat flow in aerosols and the application to the determination of particle size. A. WINKEL AND H. WITZMANN. *Zeits. f. Elektrochem.*, **46,** *pp.* 181–185, *March*, 1940.—The motion of the particles in various aerosols—paraffin, tobacco and Sudan red G in air—has been photographed by means of the apparatus here described. The colloid is strongly illuminated and photographed through a microscope on to a moving film, in a direction perpendicular to that of the beam of light. Particles of a size below 500 mμ are most suitable for this work. Comparisons are made between particle size measured in this way and by the sedimentation method. In the case of particles below 500 mμ the sedimentation method gives too high a value on account of convection effects. It is also possible to measure, from the path of the particles, the photophoresis of the cloud. The thermal motion of the particles can also be used to obtain the distribution curve of the differently sized particles in the cloud. G. G.

2298. Fine particle suspensions in organic liquids. C. R. BLOOMQUIST AND R. S. SHUTT. *Indust. and Engin. Chem.*, **32,** *pp.* 827–831, *June*, 1940. —The sedimentation volumes of glass spheres, 5 to 15 μ in dia., were determined in water and in a series of organic liquids. The sedimentation volumes in the organic liquids are identical with that in water or approach this volume as a minimum, as the system is dried more and more intensively. Flocculation of the particles causes the increase from the minimum value. The presence of water dissolved in the liquid and adsorbed on the particles produces this flocculation. The interfacial tension of the organic liquid against water is indicative of the tendency towards flocculation and the difficulty with which the minimum value may be attained. In some cases the sedimentation volume is proportional to the water content of the organic liquid, and in others the liquid must be nearly saturated before flocculation will take place. AUTHORS.

***2299. Particle size determination of colloidal systems by the supercentrifuge.** E. A. HAUSER AND H. K. SCHACHMAN. *J. Phys. Chem.*, **44,** *pp.* 584–591, *May*, 1940.—An equation is developed for the determination of the size and distribution of particles in a colloidal system from the results of experiments with the supercentrifuge. A circular slide-rule for solving the equations is described. A. J. M.

See also Abstracts 2350, 2502, 2523, 2526.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2300. A new method for calculating wave functions in crystals. C. HERRING. *Phys. Rev.*, **57,** *pp.* 1169–1177, *June* 15, 1940.—It is proposed that the wave functions and energies be calculated by solving a secular equation with wave functions χ_k which are simply plane waves made orthogonal to the core eigen-functions. The rapidity of convergence to be expected for such a procedure is discussed. Some methods for practical computation are suggested, and expressions are given for the matrix elements occurring in the secular equation. AUTHOR.

2301. Factors affecting the formation of 3/2 electron compounds in alloys of copper, silver and gold. W. HUME-ROTHERY, P. W. REYNOLDS AND G. V. RAYNOR. *Inst. of Metals, J.*, **66,** *pp.* 191–207, *June*, 1940.— The paper is theoretical. F. J. B.

2302. A redetermination of the crystal structure of lithium. H. PERLITZ AND E. ARUJA. *Phil. Mag.*, **30,** *pp.* 55–63, *July*, 1940.—Powder photographs of commercial Li are taken, the Li being enclosed in capillaries of a lithium-beryllium-borate glass. It is concluded that the amount of Na soluble in Li is less than $\frac{1}{4}$% atomic, that the lattice constant of commercial Li at 20°C. is $3\cdot501_9 \pm 0\cdot000_2$ Å and that of pure Li is between this figure and $3\cdot501_5$ Å. J. T.

2303. The structure of meteoritic iron. E. A. Owen. *Phil. Mag.*, **29,** *pp.* 553–567, *June,* 1940.—Previous results are summarized, in particular those of the author [Abstract 4494 (1939)]. A modification of the theory of the formation of meteoritic structures follows, based on the view that the transformations operating are $\gamma \rightarrow \alpha_2 \rightarrow (\alpha_1 + \gamma')$. This assumes that the initial γ state is changed directly to α_2 by rapid cooling ; α_2 will consist of a supersaturated solution of Ni in Fe in which there will be internal stresses due to distortion. Such material, being in an unstable condition, will, if heated to a moderate temperature, break up into stable components —kamacite and taenite, found in meteorites. The subsequent changes, crystal growth, production of Widmanstätten figures, etc., consequent on heat treatment, and formation of 2 varieties of plessite—plessite proper, consisting of fine crystals of kamacite and taenite, and metakamacite or granular α_2 material, are described in detail. C. A. S.

2304. Crystal structure of $NaHCO_2$. W. H. Zachariasen. *Am. Chem. Soc., J.*, **62,** *pp.* 1011–1013, *May,* 1940.—Oscillation photographs, using Cu Kα radiation, were prepared, and observed and calculated structure factors are tabulated. The crystals are monoclinic with 4 molecules per unit cell. The lattice dimensions are : a_1 6·19 ± 0·01, a_2 6·72 ± 0·01, a_3 6·49 ± 0·01 Å, α_2 121° 42′ ± 10′. The space group is $C2/c(C^6_{2h})$. Na, H and C atoms, are on 2-fold rotation axes, O atoms in general positions. Parameter values are given. There is complete resonance between the 2 C-O bonds of the formate group. The C-O distance is 1·27 Å and the bond angle is 124°. Na has 6 O-neighbours at an average distance of 2·44 Å. N. M. B.

2305. The crystal structure of KIO_2F_2. L. Helmholz and M. T. Rogers. *Am. Chem. Soc., J.*, **62,** *pp.* 1537–1542, *June,* 1940.—From a determination of the crystal structure of KIO_2F_2 it has been found that the IO_2F_2-group is composed of an iodine atom forming bonds at approximately 100° with 2 oxygen atoms and, perpendicular to the plane of these 3 atoms, 2 opposed bonds at 180° to fluorine.

2306. The crystal structure of conjugated hydrocarbons at low temperatures. 1. Butadiene. C. J. B. Clews. *Faraday Soc., Trans.*, **36,** *pp.* 749–752, *July,* 1940.

2307. Optical constants of benzamide, its homologues, and some aliphatic amides. M. L. Willard and C. Maresh. *Am. Chem. Soc., J.*, **62,** *pp.* 1253–1257, *May,* 1940.—A homologous series of 11 aromatic acid amides based on benzamide was prepared. Four of these, *p*-propyl-, *p*-butyl-, *p*-isobutyl- and *p*-*s*-butyl-benzamide, have not been reported in the literature. Optical data including refractive indices, 2 V values, optical character and crystal system, are tabulated for the aromatic amides and for a homologous series of 4 amides based on acetamide. The applicability of petrographic methods including the use of the universal stage is shown, and some attempt is made to explain the data in terms of structure and chemical constitution. N. M. B.

2308. Crystal structure of dicyandiamide. E. W. Hughes. *Am. Chem. Soc., J.*, **62,** *pp.* 1258–1267, *May,* 1940.—In view of inconclusive available evidence, the crystal structure was investigated and full structure factor data are tabulated. The monoclinic unit cell has $a = 15\cdot00$, $b = 4\cdot44$, $c = 13\cdot12$ Å, and $\beta = 115° 20'$. The space group is $C2/c$ and there are 8 molecules of $C_2N_2H_4$ per cell. The positions of the atoms were found and correspond to a molecule which is a resonance hybrid between 3 analogous non-cyclic cyanoguanidine structures differing only in the disposition of bonds. The packing of the molecules was found to be dominated by H bonds, one of which is of the rare bifurcated type. The properties of the compound are briefly discussed in relation to structure. N. M. B.

2309. The structure of liquid metals. A review. A. LATIN. *Inst. of Metals, J.*, **66**, *pp.* 177–190, *June*, 1940.—Modern theories of the structure of liquids are dealt with and the X-ray method of investigation as applied to liquids is described. A review is given of the work so far carried out on molten metals and alloys and the following general conclusions are arrived at: (1) Structural similarities exist between the liquid (especially near the freezing point) and the crystalline solid. (2) The structure of normal metals in the liquid state is best expressed in a purely statistical way; there is no definite reason to suppose that " group " formation takes place. (3) For abnormal metals, such as bismuth, there is a possibility of cybotaxis (transitory group formation) in the liquid, especially near the freezing point. (4) Some form of cybotaxis is also not unlikely in molten alloys of the intermetallic compound and eutectic types. The bearing of these conclusions on the nature of the solid ⇌ liquid transition in metals is also dealt with. AUTHOR.

2310. Formation of cristobalite and quartz by further heating of vitreous silica under high pressure by means of explosives. A. MICHEL-LÉVY AND J. WYART. *Comptes Rendus*, **210**, *pp.* 733–734, *May* 27, 1940.—By detonation of a mixture of an explosive with vitreous SiO_2 and H_2O in an Ag tube, the pressure being 3 000-4 000 kg./cm²., with addition of KOH, the tube being heated unopened for 4–13 days at 440°–720°, quartz was formed (at 720° a pumiceous glass). If only H_2O was present a glass was produced at 515°, but at 545° and 610° a cristobalite pumice. But if the tube was of Cu with H_2O alone quartz was formed at 450–650° and cristobalite pumice at 720–730°. Addition of a considerable amount of KOH gave quartz, but, with only 1% of KOH, or if CuO were added to the SiO_2, cristobalite. These results appear to be connected with formation of a pellicle of oxide or silicate on the Cu which prevents the quartz-forming action of the naked Cu, at least between 450° and 605°. C. A. S.

See also Abstracts 2352, 2445, 2446.

DENSITY.

2311. Comparison of the density of water from different localities. K. GOTO AND K. OKABE. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 76–81, *March*, 1940. *In German.*—The density of water from 8 different localities in Japan and 20 in U.S.A. and Africa has been compared with that of Osaka conductivity water, using a differential quartz float method. All samples were thoroughly purified to conductivity water standard. American H_2O seems to be very slightly heavier (ca. $+ 0 \cdot 6\gamma$) than Japanese, but since the difference is so close to the experimental error ($\pm 0 \cdot 5\gamma$) it is preferable to assume that all samples have the same isotope composition. In any case, the effect, if real, would depend far more on heavy O than on D, since the content of heavy O in water is much greater than that of D. S. J. G.

See also Abstract 2488.

DIFFUSION AND OSMOSIS.

***2312. An X-ray method of determining rates of diffusion in the solid state.** J. DuMond and J. P. Youtz. *J. of Applied Physics,* **11,** *pp.* 357–365, *May,* 1940.—Au and Cu were simultaneously deposited on a plate of glass, the Cu uniformly, the Au in stratified layers by alternately heating and cooling the trough of molten Au. Selective diffraction of Mo K radiation was observed in a specially designed X-ray spectrograph. The intensity of the diffracted image relative to the direct beam was found to fall off with time indicating a " half-life " for the stratified structure of about 2 days. A method for the study of diffusion is thus suggested, and further study shows that a purification of the spectra takes place, mainly in the beginning while the temperatures are still high. The rate of diffusion is related to the artificial " grating constant " of the strata and to the diffusion coefficient. G. G.

2313. Thermal diffusion. N. G. Schmahl and I. Schewe. *Zeits. f. Elektrochem.,* **46,** *pp.* 203–212, *March,* 1940.—Measurements on the mixing of gases by the process of thermal diffusion was carried out with the following pairs of gases: H_2, HCl; H_2, H_2S; H_2, CH_4; H_2, CO_2; CO, CO_2; and O_2, CO_2. Measurements were made of the relationship between the mixing and the time, the volume relationship of the mixture, the concentration, the temperature and the pressure. In the cases of H_2, H_2S and H_2, CO_2 a dependence of the mixing effect on pressure was observed. In addition to the experimental results on the above gas mixtures, the paper contains a theoretical discussion of the underlying problems. G. G.

***2314. Admission of pure gases to vacuum systems.** E. L. Jossem. *Rev. Sci. Instruments,* **11,** *pp.* 164–166, *May,* 1940.—It is well known that pure H_2 can be introduced into a vacuum system by allowing it to diffuse through a heated tube of Pd or Pt. This principle has been applied to other gases and other metals. Both deuterium and H_2 can be diffused through Ni, Mo, Cu, Fe, Al and SiO_2. Pure O_2 can be introduced by diffusion through Ag, Ni and Cu, whilst N_2 can be diffused through Mo, Fe and Cr, but not through Cu or Ni. Pure CO may be introduced by diffusion through Fe and Ni. No metals can be found through which He or Ne can be diffused, but they may be diffused through fused quartz. The theory and equations underlying this diffusion are considered and discussed. An apparatus for the diffusion of H_2 through Pd has been designed and is described. G. G.

2315. Revision of some conceptions of osmotic pressure. A. Thiel. *Zeits. f. Elektrochem.,* **46,** *pp.* 129–131, *March,* 1940.—Of recent years the theoretical conception of osmotic pressure has changed considerably. In spite of the known numerical correspondence between osmotic pressure and gas pressure the osmotic pressure is not a property of the dissolved substance but of the solution itself. The author applies this conception to the phenomena of diffusion, the solubility of crystals, in particular crystals of metallic salts, and to the problem of the surface tension of metals and the osmotic theory of galvanic action. G. G.

ELASTICITY AND PLASTICITY.

2316. The influence of hyperbolic notches on the transverse flexure of elastic plates. G. H. Lee. *J. of Applied Mechanics,* **7,** *A53–A56, June,* 1940.—This paper considers the solution of the 2 problems of the infinite plate with 2 symmetrically disposed hyperbolic notches, subjected to (*a*) transverse bending and (*b*) twisting. The transverse bending moments and torsional couples are so applied that the narrow section between the notches transmits the bending moment or the torsional couple. Using the Poisson-Kirchhoff theory finite expressions were obtained for the deflection and stress in each problem. AUTHOR.

2317. Materials with special temperature dependence of the elasticity moduli. H. FAHLENBRACH AND H. H. MEYER. *Zeits. f. techn. Physik*, **21**, 2, *pp*. 40–44, 1940.—Results for 2 commercial materials which have small temperature coefficients of elastic moduli are described. The Fe-Ni-Cr alloy known as WT11 is especially suitable for the construction of tuning forks or magnetostriction oscillators as it has a temperature coefficient of frequency of less than 5×10^{-6}. Another alloy, WT 8, has a temperature coefficient of elasticity of 25×10^{-6}, a magnetic saturation B-H of 2 000 to 3 000 at a value of H of 10 000 oersteds, and a Brinell hardness of 250 to 300. This material is very suitable for the construction of springs. G. O. B.

2318. Breaking strain of polystyrol glass as a function of temperature. E. JENCKEL AND P. LAGALLY. *Zeits. f. Elektrochem.*, **46**, *pp*. 186–188, *March*, 1940.—The strain/temperature curves show a maximum in the region of about 50°C. This temperature does not correspond with the freezing temperature, which is about 35°C. higher, nor with the much lower temperature at which porosity begins, as is the case in glasses of less complex molecular composition. This temperature may perhaps correspond to a second freezing point. G. G.

See also Abstracts 2387, 2398.

GRAVITATION.

2319. Eötvösian elements. S. BALLARIN. *Ricerca Scientifica*, **11**, *pp*. 71–82, *Jan.–Feb., and pp*. 139–158, *March*, 1940.—A new network for calculating the Eötvösian elements of indefinite, homogeneous cylinders is described. It is useful for the interpretation of gravimetric projections executed with the torsion balance. The second paper determines the approximate correction to the second derivative of the calculated potential for an indefinite cylinder. W. A. R.

2320. Gravity determinations in 1937 and 1938. A. H. MILLER. *Dominion Observat., Ottawa, Publ.*, **11**, 5, *pp*. 145–171, 1940.—Gravity anomalies corresponding to several methods of reduction are given for 25 stations recently established in E. Canada and Newfoundland. Of the larger anomalies the greater proportion for these stations is in pre-cambrian areas, where the more pronounced are in every case negative. A map showing results for some 150 gravity stations, so far established in Canada, accompanies the report. AUTHOR.

See also Abstract 2355.

HYDRODYNAMICS AND AERODYNAMICS.

2321. Some cases of the steady 2-dimensional percolation of water through ground. B. DAVISON AND L. ROSENHEAD. *Roy. Soc., Proc. A*, **175**, *pp*. 346–365, *June* 12, 1940.—The cases treated comprise (1) percolation through a broad embankment, (2) percolation from a dyke of rectangular section, and (3) motion of water outside a number of parallel draining tubes. The analysis employs the method of conformal representation, and the method can, in certain cases, be applied to problems in which plane seepage surfaces occur. J. S. G. T.

2322. Theorem concerning the simultaneity of the minimum of total energy and maximum flow in the case of plane permanent curvilinear flow. C. Jaeger and A. Abecasis-Manzanares. *Comptes Rendus*, **210,** *pp.* 729–731, *May* 27, 1940.—A mathematical proof of the theorem is presented. J. S. G. T.

2323. Shallow water waves transmitted in the direction parallel to a sea coast, with special reference to Love-waves in heterogeneous media. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.*, 17, *pp.* 685–694, *Dec.*, 1939.—Two cases of the propagation of water waves of the type discussed by Love are considered, viz. (1) that in which the depth of the epi-continental sea and the depth of the outer sea are both uniform, and (2) that in which, the former depth being uniform, the latter depth increases as the square of the distance from the coast. Waves in heterogeneous media are briefly discussed. J. S. G. T.

2324. Note on the slow motion of fluid. W. R. Dean. *Cambridge Phil. Soc., Proc.*, **36,** *pp.* 300–313, *July*, 1940.—[See Abstract 950 (1939).] The slow 2-dimensional motion of viscous liquid past a sharp edge projecting into the stream is considered, the motion being one of uniform shear apart from the disturbance caused by the projection. A special form is assumed for the boundary so that a method lately developed by N. Muschelišvili can be used in solving the biharmonic equation; a simple expression in finite terms is found for the stream function.

KINETIC THEORY OF MATTER.

See Abstract 2312.

LENGTH, AREA AND VOLUME.

2325. Support and manufacture of long measuring rods. A. Jotzoff. *Zeits. f. Instrumentenk.*, **60,** *pp.* 112–116, *April*, 1940. L. K.

MASS.

2326. Differential temperature error in weighing. E. Blade. *Indust. and Engin. Chem.* (*Analytical Edition*), **12,** *pp.* 330–331, *June* 15, 1940.—Weighings of a specially prepared steel plummet and a standard porcelain crucible, on a magnetically damped balance, indicate that a temperature difference between object and balance causes a weighing error proportional to the magnitude of the difference, which may persist ½ hr., and which dissipates logarithmically with time. The 17 gm. plummet exhibited a constant maximum error of 0·05 mg. per degree, and the 17 gm. crucible, 0·19 mg. per degree. Author.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2327. A significance-test for ellipticity in the harmonic dial. J. W. Mauchly. *Terr. Mag.*, **45,** *pp.* 145–148, *June*, 1940.

2328. Calculus of probability. Axiomatic method, integration. A. Weil. *Rev. sci., Paris*, **78,** *pp.* 201–208, *April*, 1940.—The characteristics of probability and frequency and the formalization of mathematical operations are briefly and critically examined; attention is directed to the contributions of Kolmogoroff and of Lebesgue to the subject of probability. J. S. G. T.

2329. Vector analysis in special relativity. W. Band. *Am. J. Phys.*, **8**, *pp.* 162–164, *June*, 1940.—The subject is discussed under the heads of fundamental turning operators, unit vectors, dyadic areas and vector volumes, reciprocal sets of 4-vectors, dyadic operators and rotations, and Lorentz rotations. By adopting a more rational system of base units it proves possible to make use of all the advantages of both tensor and vector analysis in the treatment of special relativity theory without having to introduce the unsatisfactory notion of imaginary time required on the scheme of Minkowski. The Lorentz transformation is regarded as the consequence of a dyadic rotation of the reference system of base units, and is expressed by an obvious generalization of the rotation dyadic in 3 dimensions. None of the results are essentially new, but the method of approach has proved valuable in the presentation of the subject, and it also leads to an attractive notation for use in the general theory of relativity. S. A. S.

2330. On the integral equations of continuous dynamical systems. W. H. Ingram. *Phil. Mag.*, **30**, *pp.* 16–38, *July*, 1940.—A lengthy mathematical study, employing matrices, having particular reference to the vibrating string and the electrical transmission line. S. A. S.

2331. Some formal properties of the density matrix. K. Husimi. *Phys. Math. Soc. Japan, Proc.*, **22**, *pp.* 264–314, *April*, 1940.—A mathematical study of the subject under the heads of the density matrix for a linear harmonic oscillator, Bloch's equation, Green's functions, the variational principles, a correspondence scheme by means of Heisenberg wave packets, the W.K.B. approximation, an asymptotic solution of the Bloch equation, the Boltzmann statistics, Bose statistics, Fermi statistics, reduced density matrices, introduction of the degeneration parameter, the central limit theorems, the limiting case of vanishing temperature, the Hartree-Fock approximation at an arbitrary temperature, the Thomas-Fermi approximation, an alternative method of obtaining the reduced density matrices, relation to the method of second quantization, and thermodynamics in the theory of second quantization. S. A. S.

MECHANICS, QUANTUM.

2332. Attempt at a synthesis of wave mechanics and corpuscular mechanics. M. Planck. *Ann. d. Physik*, **37**, 4, *pp.* 261–277, *April*, 1940. —The author attempts to modify the wave mechanics in such a way that the limits of validity may be determined. The wave function ψ is replaced by a function w by means of the equation $\psi = e^{iw/h}$. The condition that the Schrödinger equation must hold for the modified function ψ, and that the terms containing h must vanish for $h \rightarrow 0$, is investigated in relation to the motion of an electron in the field of a H nucleus. The laws of the modified wave mechanics agree approximately with those of corpuscular mechanics provided the azimuthal quantum number is very large, except for a small area round the apex of the hyperbolic orbit of the electron, where the electron motion follows the laws of wave mechanics. The radial component of the impulse assumes a complex value, while the azimuthal component and the energy are constant throughout the motion. L. K.

2333. Existence and magnitude of electronic charges. A. Landé. *Frank. Inst., J.*, **229**, *pp.* 767–774, *June*, 1940. [See Abstract 3660 (1938).]—In order to quantize Dirac's classical point electron the author

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supplements Einstein's classical equation $(E/c)^2 - p^2 = b^2$ with a reciprocal classical equation $(c\Delta t)^2 - (\Delta r)^2 = a^2$ where $b = mc$ and a is Dirac's signal radius. Δt is the time saved by a light signal in various states of motion of the electron and a/c is the rest time saved. Former efforts at obtaining an integral equation for the probability amplitude have been rectified by Born [Abstracts 3896 and 4223 (1939)]. There is no solution to the integral equation, however, unless advanced and retarded phases are introduced simultaneously along with Dirac's advanced and retarded potentials. A transcendental equation is obtained for the eigen-value $\mu = \alpha\gamma$, where α is the Sommerfeld fine-structure constant and γ is the numerical factor in Dirac's signal radius $a = \gamma e^2/mc^2$. The smallest eigenvalue is $\mu = 0 \cdot 0299$. That is, $ab = h\mu = h/210$. AUTHOR.

2334. On the establishment of grand canonical distributions. R. C. TOLMAN. *Phys. Rev.*, **57,** *pp.* 1160–1168, *June* 15, 1940.—It is shown that the establishment of a grand canonical distribution is to be expected in an ensemble which represents the attainment of equilibrium in an " open " system, connected with appropriate reservoirs for supplying the various kinds of molecules involved, and in thermal contact with a large heat bath at a given temperature. AUTHOR.

2335. Degeneracy in non-relativistic Bose-Einstein statistics. D. V. GOGATE AND D. S. KOTHARI. *Indian Journ. Phys.*, **14,** *pp.* 21–36, *Feb.*, 1940.—Simple and direct proofs (substantially following Kennard and Condon) are given of the 3 distribution laws, viz. Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution. The properties of Bose-Einstein degenerate gas are discussed and compared with those of Fermi-Dirac degeneracy. AUTHORS.

2336. The interaction between nitrogen molecules. J. CORNER. *Faraday Soc., Trans.*, **36,** *pp.* 780–781, *July,* 1940.—A recalculation of the interaction of nitrogen molecules, on conventional lines, eliminates some anomalies in the derived observable properties of this substance. AUTHOR.

See also Abstracts 2300, 2487, 2519.

PHILOSOPHY OF SCIENTIFIC METHOD.

2337. Considerations concerning the fundaments of theoretical physics. A. EINSTEIN. *Science*, **91,** *pp.* 487–492, *May* 24, 1940. *Nature*, **145,** *pp.* 920–924, *June* 15, 1940. (*Abstract.*)—The realm of physics is defined as that part of our knowledge which is capable of being expressed in mathematical terms. The search to find a unifying theoretical basis which would constitute the foundation of physics has not yet been successful. Newton's concepts were fruitful until the facts of electrodynamics, particularly the wave theory of light, led to the development of " field-physics". Field theory is unable to furnish an interpretation of matter. There now exist 2 theoretical systems which are essentially independent, the theory of relativity and the quantum theory. The former, in its special or restricted form, disposed of the possibility of retaining the concept of action at a distance and, in its general form, it shows how to formulate natural laws in such a way that their form is identical for co-ordinate systems in any kinds of states of motion. The theory of relativity lacks finality in that the 2 components of the total field, the gravitational and the electromagnetic, are logically unconnected and the atomistic structure of matter does not appear. The quantum theory gives a good representation of facts with respect to atomic processes but it is found impossible to associate it with definite motions of mass points. This difficulty is avoided by the assertion that it leads only to statistical statements and predictions of the results of measurements but not to descriptions of how events actually occur in space and time. It appears that any decision with respect to the deterministic structure of matter is impossible because of the atomistic structure of experimental apparatus. The author, however, does not believe that the idea of direct representation of physical reality in space and time must be abandoned or that natural events occur only by chance. A. M. T.

2338. The development of physical thought. C. E. Guye. *Arch. des Sciences*, **22,** *pp.* 63–70, *Jan.–Feb., and pp.* 73–88, *March–April,* 1940.—Physics from the time of Newton to the appearance of the electromagnetic theory is considered. The fundamental influence of astronomical science on the concept of absolute determinism is indicated. The parts played by the theory of relativity and the quantum theory which destroyed absolute determinism are described. The new developments enabled many apparently independent branches of knowledge to be unified, but it is pointed out that deductions from generalizations have proved to be much simpler than inductions from special cases in biology and psychology as well as in physics and chemistry. The tendency at present is to modify the idea of absolute determinism to statistical determinism, particularly in the region of atomic processes, but the avenues open to future research are rich in promise, as for example the discovery of the significance of Planck's constant and the synthesis of new atoms. A. M. T.

RELATIVITY AND ETHER.

2339. Doppler effect from moving mirrors. H. E. Ives. *J.O.S.A.*, **30,** *pp.* 255–257, *June,* 1940.—The author writes down the formula for the Doppler effect for light reflected from a moving mirror, source and observer being stationary in the ether; considers the modified formula when the whole system is in uniform motion in the ether and shows how the Fitzgerald contraction and the Larmor-Lorentz change of clock rate operate to defeat any attempt to use the effect to detect absolute motion through the ether. W. S. S.

2340. Modification of a relativity postulate. S. Sulaiman. *Phil. Mag.*, **30,** *pp.* 49–54, *July,* 1940.—The deflection of light by the sun is usually calculated by using the special Schwarzschild-field solution of Einstein's gravitational equations. The predicted deflection is $1''\cdot 74$ whilst observation indicates that the value is probably about $2''\cdot 2$. The author proposes that the Schwarzschild field be slightly modified by assuming that light tracks in it are geodesics along which the interval is not zero but has a small finite value. If it is then assumed that a light track coming from a distant star and grazing the sun is approximately a hyperbola in Euclidean space, the theoretical prediction of $1''\cdot 74$ can be raised to about $2''\cdot 5$. G. C. McV.

See also Abstract 2329.

SOLUTION.

***2341. Polarographic investigations on complex ions in aqueous solution.** M. v. Stackelberg and H. v. Freyhold. *Zeits. f. Elektrochem.*, **46,** *pp.* 120–129, *March,* 1940.—The theory underlying the method as well as suitable apparatus to carry out the experiments are described. The results of experiments with zinc oxalate complexes, with iron oxalate and iron fluoride complexes, with copper ammonia and copper chloride complexes, are given. G. G.

2342. Solubility of Cd and Zn oxalates in salt solutions. W. C. VOSBURGH AND J. F. BECKMAN. *Am. Chem. Soc., J.*, **62**, *pp.* 1028–1031, *May*, 1940.—In order to correct or verify available results on the ionization constants and the interpretation of solubility data, solubility measurements are given for CdC_2O_4 in solutions of $KClO_4$, $Cd(ClO_4)_2$, K_2SO_4, and $CdSO_4$. The increase of solubility with concentration in solutions of the last 2 and the constancy in $KClO_4$ solutions can be explained by assuming the existence of the ions $CdC_2O_4 \cdot Cd^{++}$ and $CdC_2O_4 \cdot SO_4^{=}$ and regarding $CdSO_4$ as incompletely dissociated. The solubility of ZnC_2O_4 in ZnS solutions can be explained similarly if the ion $ZnC_2O_4 \cdot Zn^{++}$ is postulated. The instability constants of the ions $Cd(C_2O_4)_2^{=}$ and $Zn(C_2O_4)_2^{\equiv}$ are recalculated. N. M. B.

2343. Freezing point and solubility data for the system Cl_2O-H_2O. C. H. SECOY AND G. H. CADY. *Am. Chem. Soc., J.*, **62**, *pp.* 1036–1038, *May*, 1940.—Freezing point composition data of the system and mutual solubilities of the 2 partially miscible component liquids are reported for the entire range. No data being available on the possible existence of hydrates of HClO, this investigation shows that the solid phase formed from solutions of concentration greater than 11·7 mol.% Cl_2O has the composition $HClO.2H_2O$. N. M. B.

2344. Apparent and partial molal volumes of NaCl and HCl in mixed solutions. H. E. WIRTH. *Am. Chem. Soc., J.*, **62**, *pp.* 1128–1134, *May*, 1940.—The partial molal volumes of NaCl are decreased at constant total volume ionic strength by the addition of HCl, while those of HCl are increased at constant total concentration by the addition of NaCl. In each case the variation is a linear function of the added component concentration. The partial molal volumes of water were determined in the mixed solutions. At a given concentration they are largest in solutions of pure HCl and smallest in pure NaCl solutions. Results are interpreted in terms of changes in the structure of water caused by ions in solution. N. M. B.

See also Abstracts 2420, 2348, 2465.

SURFACE PROPERTIES.

2345. Monolayers on solids. J. K. ROBERTS. *Chem. Soc., J.*, *pp.* 773–775, *June*, 1940.—Certain statements by Langmuir [Abstract 1735 (1940)] are discussed or corrected, and numerical calculations are given based on the author's work. AUTHOR.

2346. Microtome measurements of the adsorption of hydrocinnamic acid in the surface of its aqueous solutions. J. W. MCBAIN, T. F. FORD AND G. F. MILLS. *Am. Chem. Soc., J.*, **62**, *pp.* 1319–1324, *June*, 1940.—The experimentally determined adsorption of β-phenylpropionic acid in the surface of its aqueous solution as measured by the microtome method is not completed immediately, even after efficient stirring, and may require several hrs., whereas diffusion processes would require only about 1/10 sec. Further, the surface tension is not finally established until after much longer periods of time. The final measured absolute adsorption seems to be slightly less than that calculated by the Gibbs theorem from surface tensions of comparable age and closest approach to equilibrium. H. H. Ho.

2347. A theory of chromatography. J. N. Wilson. *Am. Chem. Soc., J.*, **62,** *pp.* 1583–1591, *June*, 1940.—A theory of chromatographic analysis has been developed on the basis of the assumption that equilibrium between solution and adsorbent is instantaneously established and that the effects of diffusion can be neglected. The theory accounts qualitatively for the separations effected in chromatographic analysis, for the uniformity of colour in the adsorption bands, and for the sharpness of the edges of the bands.

2348. Change with time of the surface tension of solutions of sodium cetyl sulphate and sodium lauryl sulphate. G. C. Nutting, F. A. Long and W. D. Harkins. *Am. Chem. Soc., J.*, **62,** *pp.* 1496–1504, *June*, 1940.—The change in surface tension was measured in various concentration ranges. The changes were followed in intervals of 2 minutes to 3–6 hrs. The effects of various uni-, di- and trivalent ions at several concentrations were measured on $0 \cdot 0004\,N$ sodium cetyl sulphate and $0 \cdot 004\,N$ sodium lauryl sulphate. Surface tensions were measured by the ring method and full experimental details are included. In the cetyl sulphate solutions without added electrolyte at concentrations below $6 \times 10^{-4}\,N$ a rapid fall in tension was found followed by a slow fall, linear with time, at the same rate for all solutions. At concentrations higher than $6 \times 10^{-4}\,N$ the initial fall is small and the surface tension soon reaches a value of about 35 dynes/cm. The effect of electrolytes is the same as an increase in cetyl sulphate concentration and the effectiveness of positive ions increases rapidly with the valence. In the lauryl sulphate solutions the initial fall is not so marked and is followed, usually, by a broad minimum, while the effect of electrolytes is again to hasten attainment of a static tension. The results are discussed. H. H. Ho.

2349. Measurements of the pressures due to monolayers at oil/water interfaces. F. A. Askew and J. F. Danielli. *Faraday Soc., Trans.*, **36,** *pp.* 785–794, *July*, 1940.—The surface balance has been adapted for use at the interface between aqueous solutions and brombenzene. Surface pressure measurements have been made on ovalbumin, alginic acid, trimethyl cellulose, α-amino-palmitic acid and *n*-eicosoic amide. Substances occupy larger areas per molecule than would be expected at the air-water interface ; this is attributable to the brombenzene breaking down the adhesions between the non-polar portions of adjacent molecules. Ovalbumin spreads more rapidly, more completely and to larger areas, than at the air/water interface. The effect of *p*H on ovalbumin films has been studied between *p*H 1 and 7. Authors.

2350. Molecular interactions at oil/water interfaces. Parts I and II. J. H. Schulman and E. G. Cockbain. *Faraday Soc., Trans.*, **36,** *pp.* 651–668, *June*, 1940.—Part I deals with molecular complex formation and the stability of oil-in-water emulsions. It is shown that molecular interactions occurring at a " nujol "/water interface are closely analogous to those at an air/water interface studied with the Langmuir trough apparatus. The stability of " nujol "-in-water emulsions depends on the properties of the interfacial film of emulsifying agent. The stability of the interfacial complex film is markedly increased by the presence of excess water-soluble molecules above that necessary for a monolayer around the droplets, whereas only a monolayer is necessary for the oil-soluble component. Part II considers phase inversion and stability of water-in-oil emulsions. Emulsions of water in " nujol " are obtained when emulsifying agents are added which form interfacial films possessing no electric charge but considerable rigidity. Oil-in-water emulsions are inverted to water-in-oil emulsions if treated in such a way as to make these conditions. The conditions required for the formation of water-in-oil emulsions are similar to those necessary for the production of multi-layers on metals using the Langmuir-Blodgett technique. H. H. Ho.

2351. Work of adhesion to surfaces of solid organic compounds. P. A. Thiessen and E. Schoon. *Zeits. f. Elektrochem.*, **46,** *pp.* 170–181, *March,* 1940.—The measurement of the work of adhesion between a liquid and a solid surface gives a very useful method of determining the polarity of the solid surface. This method has been applied to the investigation of organic substances and thus to the determination of the atomic groups in the upper layer. Further, an approximate value for the surface tension of the solid-liquid and of the solid-gas phases can be calculated. A check on the first series of results, i.e. the composition of the surface of the organic substance, has been obtained by the use of a radioactive method previously described by Paneth and Vorwerk [*Zeits. f. phys. Chem.*, **101,** *p.* 445, 1922]. The theoretical basis of these experiments is described as well as the practical methods by which they are carried out. G. G.

2352. Cybotaxis at interfaces. T. H. Hazlehurst and H. A. Neville. *J. Phys. Chem.*, **44,** *pp.* 592–600, *May,* 1940.—The existence of structural groups in liquids (cybotaxis) is more marked at interfaces, since in the bulk of the liquid there is lack of anchorage or directive influence. Liquid surfaces may therefore have a high degree of orderliness, amounting in some cases almost to crystallinity. Cybotaxis at liquid/air interfaces accounts for the existence of primary rolling drops. The stability of a bubble at a liquid/liquid interface depends on cybotaxis in the lower liquid. At H_2O/oil interfaces an air bubble will usually break through from the H_2O side, but not from the oil side. Oil drops will break through from the H_2O side, but usually H_2O drops will not from the oil side. If cybotaxis alone is operative, a H_2O-in-oil emulsion is more stable than the conjugate system. In thixotropic systems, cybotactic groups exist as spines or tentacles from active spots on neighbouring particles, forming bridges offering resistance to lateral shear. Drops of an immiscible liquid, or solid particles, may rest at a liquid/liquid interface in contact with both liquids if equilibrium conditions are satisfied, but dual liquid contact is apparently impossible for bubbles of gas. A. J. M.

See also Abstract 2488.

VISCOSITY AND FRICTION.

2353. Viscosities of linear polyesters. Exact relationship between viscosity and chain length. P. J. Flory. *Am. Chem. Soc., J.*, **62,** *pp.* 1057–1070, *May,* 1940.—Measurements of the viscosities (η) of 5 molten linear polyesters having average molecular weights (M_w) of 200 to over 10 000 show that log η is a linear function of the square root of the weight average chain length (Z_w) throughout this range. Viscosities of mixtures of 2 polyesters, one having a low and the other a high M_w agree with the same relationship using Z_w for the mixture. Thus the η-Z_w relationship does not seem to depend on the type of distribution of species in the polymer. The η-temperature coefficient is independent of M_w, and is not many times greater than that found for similar monomeric substances. It is concluded that the elementary process responsible for viscous flow must consist of displacement of only a small section of the chain, and that this elementary process is the same for polymers of all sizes. The utility of the η-Z_w relationship for the simple and accurate determination of molecular weights is discussed. Densities and thermal expansion coefficients of polyesters are reported, and an analysis of errors incident to M_w determination by end-group titration is given. N. M. B.

See also Abstract 2488.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

See Abstract 2303.

COSMOGONY.

2354. Origin of the solar system. R. A. Lyttleton. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 546–553, *May,* 1940.—The paper refutes criticisms of the author's theory made during the last few years. The nature of the problem makes precise calculations impossible. The choice of initial masses and velocities of the bodies concerned are not *ad hoc* assumptions, and their restriction to narrow ranges is not a valid objection. The additional energy required by the double-star hypothesis can be reasonably provided by an increase in the velocity of the intruding star, the presence of H on the major planets is not inexplicable, and the complexity of the initial conditions is not an argument against their existence. The assumption of a 3-body encounter seems inevitable in view of the concentration of 98% of the angular momentum of the solar system in 0·2% of its mass. A. Hu.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2355. Modification of Newtonian law of gravitation. J. Chazy. *Comptes Rendus,* **210,** *pp.* 713–716, *May* 20, 1940.—A small correction is introduced in the Newtonian law by which the constant of gravitation is multiplied by a factor $(1 + r'/v)$ where r' is the time derivative of the distance separating the gravitating bodies and v is a very large number with the dimensions of a velocity. Secular corrections to the classical planetary motions become necessary, in particular in the longitudes. From observations of Mercury's transits an upper limit can be fixed to its acceleration, giving a lower limit for v of 10^7 times the velocity of light. Assuming a law of force varying with the time, the author calculates the corrections to the derivations of the planetary semi-axes, eccentricities, inclinations and nodal longitudes. A. Hu.

2356. The spiral arms of a configuration of rotating compressible mass having uniform density and surrounding an incompressible spheroid of homogeneous mass. A. C. Banerji. *Indian Journ. Phys.,* **14,** *pp.* 67–77, *Feb.,* 1940.—The size of the central mass is assumed to be small compared with that of the outer boundary of the gaseous structure. The density of the gaseous structure can only be uniform if the angular velocity is variable and satisfies a certain relation. The relation between the distance from the axis of rotation and the angular velocity is determined. Particular cases of our galactic system and the Andromeda nebula have also been considered. For spiral formation it is found that the diameter of the inner central core should be less than 270 parsecs for the galactic system and less than 560 parsecs for the Andromeda nebula. AUTHOR.

NEBULÆ.

See Abstract 2376.

PLANETS.

2357. The atmospheres of the planets. R. M. PETRIE. *Roy. Astron. Soc., Canada, J.*, **34,** *pp.* 137–145, *April*, 1940.—The author gives the evidence for and against planetary atmospheres by (*a*) surface appearances, (*b*) albedo, or reflecting power, (*c*) twilight and refraction effects, (*d*) spectroscopic effects, evidence from absorption bands, (*e*) gravitation effects. Venus, Jupiter, Uranus and Neptune have distinct atmospheres while Mercury and the moon show none, and Mars also fails to show conclusive spectroscopic evidence of atmosphere though its polar caps demonstrate water. [See Abstract 1033 (1935).] A. S. D. M.

2358. The suitability of Eros for the accurate determination of the solar parallax. H. SPENCER JONES. *Roy. Astron. Soc., M.N.*, **100,** *pp.* 422–434, *April*, 1940.—Discussing the Eros (1931) observations, Vick concludes that Eros is a complex system of at least 3 bodies, its brightness centroid moving with a varying period about its mass centroid, and so is not suitable for obtaining an improved solar parallax value. The periods found are 12·5311 and 79·6845. For so short a period as 12½ min. a separate reduction of individual exposures is needed, and this is obtained from the Dearborn series of Jan. 17, 20 and 21 (1931), yielding no evidence of any such periodicity. It is concluded that Vick's method is at fault. A small variation in declination of about $0''\cdot05$ with a period of $2^{h}38^{m}$ is detected, but its range does not seem related to increase in amplitude of the known variation of Eros brightness and has no systematic effect on the solar parallax determination. A. S. D. M.

STARS.

2359. Photographic determination of stellar parallaxes with the 60- and 100-in. reflectors. A. VAN MAANEN. *Mt. Wilson Observat., Contrib. No.* 630. *Astrophys. J.*, **91,** *pp.* 503–505, *June*, 1940.—Trigonometric parallaxes determined with the 60- and 100-in. reflectors are given for 25 fields, including 26 stars, 20 of which have photographic absolute magnitudes of + 10 or fainter; 5 are even + 15 or fainter. A list is given of the 21 stars known at present for which the absolute photographic magnitude is fainter than + 15. AUTHOR.

2360. The Wolf-Rayet spectroscopic binary HD 193576. O. C. WILSON. *Mt. Wilson Observat., Contrib. No.* 623. *Astrophys. J.*, **91,** *pp.* 379–393, *May*, 1940.—A determination of the mass lower limit of a Wolf-Rayet star (HD 193 576) whose period is $4^{d}.2125$; elements of the system are given. A striking result is the difference of 90 km./sec. between the γ-axes of the components; here the radial velocity of the binary (− 34 km./sec.) is that given by the γ-axis of the B-type component, and the γ-axis of the Wolf-Rayet star is + 56 km./sec. and indicates a red shift of the emission bands of about 90 km./sec. [see following Abstract]. Its distance and absolute magnitude are 740 parsecs, and — 1·7 vis. mag. [see Abstract **3944 (1939)**]; the minimum masses of the Wolf-Rayet and B-type components are 9·74 ⊙ and 24·8 ⊙, respectively. If the Wolf-Rayet star radiates as a black body its density may be taken as of the same order as the sun; also, it appears to be about 4th mag. brighter than would be estimated from its mass on the empirical mass-luminosity relation basis. A. S. D. M.

2361. Physical characteristics of Wolf-Rayet stars. O. C. WILSON. *Mt. Wilson Observat., Contrib. Astrophys. J.*, **91,** *pp.* 394–407, *May,* 1940.—Deals with the interpretations of the red shift of the Wolf-Rayet binary 193 576 [see preceding Abstract]. The author states 5 possible causes of the wavelength shifts originating in a shell ejected by a central star: (1) motion of the star and envelope as a whole; (2) purely geometrical effects (occultation, etc.); (3) Stark effect; (4) absorption effects; (5) relativistic gravitational displacement. The first 3 are rejected, and the 4th is doubtful. This implies that the radii of the shells giving rise to the emission bands cannot exceed 1/10 of the sun's. The gravest objection is the very high surface temperatures entailed for the nuclei which would be extremely dense and would form the massive analogues of the white dwarfs. A decision might be made by a study of the emission band contours. A. S. D. M.

2362. Spectroscopic luminosities of stars of types G and K in 2 selected fields. P. C. KEENAN. *Astrophys. J.*, **91,** *pp.* 506–527, *June,* 1940.—Spectroscopic luminosities and revised spectral types were determined for stars brighter than the 8th visual magnitude, having Henry Draper types G5–K5, in 2 fields—one in Cassiopeia (146 stars) and the other centred at the north galactic pole (120 stars). For this purpose the luminosity classes defined by Morgan were calibrated in terms of absolute magnitude by means of spectrograms of 235 bright stars of known trigonometric parallax. From the data for the Milky Way field the main course of the luminosity function for K0 stars in the vicinity of the sun was derived. The numbers of stars per unit volume increase steadily with luminosity class, in going from supergiants to dwarfs. The zero point of the function was furnished by the giants, for which a space density of 8×10^{-5} stars per cubic parsec was found. A plot of the distribution in distance of the individual stars indicates the marked falling-off in numbers of stars in the higher luminosity groups in the direction of the galactic pole at distances greater than about 200 parsecs from the sun. AUTHOR.

2363. Spectrographic observations of peculiar stars. P. SWINGS AND O. STRUVE. *Astrophys. J.*, **91,** *pp.* 546–620, *June,* 1940.—The spectra of several absorption O-type stars showing vestiges of Wolf-Rayet emission have been investigated from λ 3 300 to 6 700. The absorption spectrum consists mainly of H, He II, He I, O III, O IV, N III, N IV, and Si IV. The emission lines show a P Cygni character and are confined to H, He I, and a few transitions of He II, N III, N IV, N V, C III and Si IV. The location of the expanding shell giving rise to the emission and absorption lines is estimated. The visual spectrum of P Cygni reveals strong Fe III lines originating from metastable levels (dilution effect). Lines of other elements show a peculiar selectivity of the emission lines. The spectra of 3 other P Cygni type stars (Z Canis Majoris, BD + 47° 3 487, and BD + 11° 4 673) are described, especially in connection with the phenomena arising in expanding shells. RY Scuti shows a strong system of forbidden [Fe III] lines, and the variations in the spectrum of this star are discussed. The ultra-violet region of the spectrum of ζ Tauri shows several sets of absorption lines (H, He and ionized metals) arising from the reversing layer and from various layers in the surrounding shell. The a^5D — $4p^5P^0$ multiplet of Fe III was the most conspicuous feature in the visual region of γ Cassiopeiae in March, 1940. New data are given for the spectra of several other stars with extended shells (MtW **143**, HD **218 393**, HD **160 529** and HD **190 073**). A group of stars showing forbidden [Fe II] lines is discussed (WY Geminorum, W Cephei, B **1 985**, B **5 481** and HD **45 677**); and new [Fe II] multiplets are found in the ultra-violet region of these objects. The spectra of 4 binary systems showing simultaneously an M-type spectrum and forbidden lines of high excitation are described in detail. The spectroscopic phenomena accompanying the recent outburst of Z Andromedae are discussed; the continuous absorption in the shell plays an important rôle in the relative intensities of the emission and absorption components of the P Cygni type lines. The 2 stars AX Persei and CI Cygni have very similar bright-line spectra of which the nebular part shows a very high excitation; besides H, He I and He II, the strongest lines are due to [Fe VII] and [Ne V], and there is good evidence in favour of [Fe X]. The temperature of the nucleus exciting these nebular lines must be of the order of 150 000° or more. Another multiple object of lower excitation is R Aquarii, and new spectroscopic data show the occulation effect of the nebula by the TiO atmosphere of the late-type component. There is good reason to believe that the binary nature of a star stimulates the process of shell formation. AUTHORS.

2364. Contributions toward a physical model of γ Cassiopeiae. R. B. BALDWIN. *Astrophys. J.*, **92,** *pp.* 82–113, *July*, 1940.—The light curve and the temperature curve of γ Cassiopeiae are correlated in a peculiar manner. An explanation is that the photosphere of the star is variable in size and that a reduced colour temperature depends on an increase in the extent of the radiating surface relative to the available energy. The law of conservation of angular momentum may be used to explain these correlations. The broad absorption lines are observed to change in width; and if this is interpreted as a change in the velocity of rotation, we immediately have relative radii of the star for all dates covered by measures of the absorption width. The original absolute magnitude and the light curve permit computation of a temperature curve, which is found to be in agreement with the observed temperature curve. This principle allows a determination of the radii of the layers of emission. It is found that the atmosphere is stratified and that it pulsates in a manner similar to the photosphere but with a moderate lag. Equivalent widths of certain sharp absorption lines of helium and hydrogen have been measured, and the method of Struve and Wurm has been applied to give the distance from the photosphere to the " shell " in which the lines were produced. The results are consistent with the radii determined from the broad absorption and emission lines; the sharp absorption lines are produced in the outermost layers. Variations in the emission intensity ratios of the 2 components of the lines of 10 elements are shown to exist and are discussed.

AUTHOR.

2365. Spectrophotometric observations of the minimum of ζ Aurigae. C. A. WIRTANEN. *Astrophys. J.*, **92,** *pp.* 122–125, *July*, 1940.—The variation in brightness of ζ Aurigae during the recent eclipse has been observed photographically at different wavelengths, using the 10 in.

Cooke camera equipped with a coarse grating and a low-dispersion prism. Plates were measured with the Schilt microphotometer. Seven early-type stars in the same field, ranging from 3·3 to 7·3 mag., served to establish the zero point and the scale at each wavelength. AUTHOR.

2366. Heterochromatic surveys of infra-red variable stars. C. HETZLER. *Astrophys. J.*, **92**, *pp.* 59–81, *July*, 1940.—Seven late M-type variables—T Cep, R Cas, R Leo, R Aql, *o* Cet, X Oph, and R Aqu—are included in this first of a series of papers on the heterochromatic photometry (particularly at 8 500 Å) of about 40 infra-red variable stars. The average relative magnitude ranges are 4·94, 4·29 (first 2 stars only), 4·73, 2·43, and 1·95 in the ultra-violet, photographic, visual, 8 500 Å and 9 100–9 250Å regions, respectively. The tri-colour condition for a black star is shown to be that the plot (designated as " slope-index ") of any 2 colour indices gives a straight line whose slope depends only on the wavelengths and which passes through the origin. The indices involving the ultra-violet and infra-red magnitudes come closest to meeting this condition, and temperatures from these indices are therefore considered most reliable. Using these temperatures (averaging 2 800° at max. and 2 100° at min.), the differential absorption in the visual region between maxima and minima is calculated for each of the variables, being least for R Cas and R Leo, and around 2 mag. for each of the others, the average being 1·4 mag. It is shown that, for a black variable, star magnitudes at any wavelength plotted against those at any other give a straight line of slope equal to the ratio of the wavelengths. Plots of visual against 8 500 Å magnitudes give straight lines (except for curvature near the maxima of stars having a delayed infra-red drop and near the minima of stars having companions) of medial slopes 1·92, 1·87, 1·82, 1·94, 1·95, 1·80 and 1·92, for the 7 stars, respectively, averaging 1·89, as compared with the theoretical value 1·54. The delayed infra-red drop and the steeper slopes near maxima, particularly in *o* Ceti, are interpreted as an effect of band absorption which is not synchronous with, or proportional to, the temperature change ; and the generally steeper slopes are due primarily to a superposition upon the black-body slope of an absorption which, on the average, increases linearly toward minimum ; but changes of diameter would also contribute to this effect. The ultra-violet magnitudes plotted against the infra-red magnitudes give straight lines of slopes near the theoretical value of 2·3 ; hence, band absorption is probably the chief factor of departures in the visual region. The *y*-intercepts give the radii and possible changes in radii, if we know the individual absolute magnitudes. Extrapolation of the medial straight-line portions of the visual *minus* infra-red and ultra-violet *minus* infra-red slope-index curves yield the visual and ultra-violet magnitudes, and hence the colours, of the companions to *o* Cet, X Oph and R Aqu. AUTHOR.

2367. A study of He I lines in the Balmer continuum. F. E. ROACH AND L. BLITZER. *Astrophys. J.*, **92**, *pp.* 50–58, *July*, 1940.—Measurements of the equivalent widths of He I lines of the diffuse series have been made for 22 stars of classes Oe 5 to B5. In all cases the higher members of the triplet diffuse series, located in the Balmer continuum, are abnormally weak. This weakening has been interpreted in terms of an increase in the continuous absorption coefficient in the Balmer continuum. A comparison of results with Unsöld's theoretical calculations suggests a high hydrogen content for the stars of this study. AUTHORS.

2368. Stellar temperatures. G. P. Kuiper. *J. of Applied Physics*, **11**, *pp*. 241–249, *April*, 1940.—A general review is given of the determination of the temperatures of astronomical bodies. The colour and effective temperatures of stars are defined and the method of temperature determination from spectral lines is described. Recently calculated effective temperatures for 8 white dwarfs are given.. Planetary temperatures, the temperature of interstellar matter and the internal temperatures of stars, are also discussed. G. C. McV.

2369. On the capture of interstellar matter by stars. R. d'E. Atkinson. *Cambridge Phil. Soc., Proc.*, **36**, *pp*. 314–322, *July*, 1940.—The derivation given by Hoyle and Lyttleton [Abstract 4249 (1939)] for an accretion formula proposed by them is examined. A number of arguments against its validity are put forward, especially that, on the one hand, their capture radius depends on the theorem that, if the velocity of certain masses of gas after collision is less than the velocity of escape at the point, they will not in fact escape, while, on the other hand, it is clear (and is now admitted) that the gas cannot in fact move with this velocity at all. It is also shown that since, *ex hypothesi*, the individual molecules will all, on the average, retain their hyperbolic velocities, there is not the compelling reason for their capture that there appeared to be in Hoyle and Lyttleton's argument, where only the mean radial velocity of the centre of gravity of the mass was considered. Further, it seems improbable that the temperature of the interstellar matter can be low enough for the initial assumptions of their theory to hold. Author.

2370. Note on Atkinson's paper. F. Hoyle and R. A. Lyttleton. *Cambridge Phil. Soc., Proc.*, **36**, *pp*. 323–324, *July*, 1940.

2371. On the accretion of interstellar matter by stars. F. Hoyle and R. A. Lyttleton. *Cambridge Phil. Soc., Proc.*, **36**, *pp*. 325–330, *July*, 1940.—The investigations of the present paper in conjunction with those of previous papers recently published [Abstract 4249 (1939)] lead to the conclusion that regions occupied by massive stars and close binary systems are parts of the galaxy where the density of the cosmical cloud rises to the order of 10^{-21} gm./cm^3. It is therefore only to be expected that O and B stars and very massive stars of other types such as Cepheids will tend to lie near the galactic plane or towards the centre of the galaxy unless they belong to a local star-group. Authors.

2372. The opacity of gas mixtures in stellar interiors. P. M. Morse. *Astrophys. J.*, **92**, *pp*. 27–49, *July*, 1940.—The opacity of mixtures of H, He, O, Na, Mg, Si, K, Ca and Fe, is computed for any proportions of H and He, and for 4 different mixtures of the heavier elements, for temperatures from 4×10^4 to 10^9°C., and for densities from 10^{-3} to 10^4 gm./cm^3. Absorption cross-sections for Coulomb-field wave functions are used ; but these are corrected for the screening of filled shells by using effective nuclear charges and quantum numbers, and for the effect of pressure ionization (excluded volume) by the use of the solutions of the Thomas-Fermi equation for electronic distribution in dense materials. A table of correction factors for Kramers' opacity formula (guillotine factors) is given for the 4 mixtures, for the ranges of temperature and density covered. Instructions for determining the value of the opacity, for a given temperature and density and for intermediate chemical mixtures, are given. Comments on the dependence of the opacity on the chemical constitution of the mixture and on the effect of these results on the calculation of hydrogen concentrations in stars are included. Author.

2373. Recent evidence on the nuclear reactions in the carbon cycle. H. A. Bethe. *Astrophys. J.*, **92,** *pp.* 118–121, *July,* 1940.—New experimental results provide better estimates of the probabilities of nuclear reactions involved in the carbon cycle than those available previously. The lifetimes of C^{12} and N^{14} are found to be almost equal, namely $2\cdot5 \times 10^6$ years and 4×10^6 years, respectively. The abundances of C^{12} and N^{14} should be similar in main-sequence stars. The combined abundance of C and N should be about 1% by weight—in sufficient agreement with observational evidence. The ratio $N^{14} : N^{15}$ in the sun should be $2 \times 10^5 : 1$, considerably greater than on earth (260 : 1). [See Abstract 1550 (1939).]
Author.

2374. Attempt at determination of the duration of stellar evolution. P. Rossier. *Arch. des Sciences,* **22,** *pp.* 89–98, *March–April,* 1940.—Numerical methods are used to integrate the differential equation giving the rate of loss of mass of a generalized star in terms of its radius and temperature. Simple evolution through giants of class M, K, G, F to A and thence through dwarfs in the reverse order is considered exceptional; a cataclysmic type in which a nova is formed and class O and B stars result is more usual. A table gives the time spent by the average star in the various sub-classes. The high temperatures of the novae and O and B stars impose a rapid evolution on such stars, so that the total lifetime of a star from red giant to red dwarf is of the order of 10^{13} yr. whether the evolution is simple or complicated by catastrophes. The rate of evolution of giants (particularly giant G stars) is rapid compared with that of dwarfs; this explains the high frequency of occurrence of *d*K stars. The other maximum frequency, amongst A stars, is perhaps due to the convergence at this type of the 2 evolutionary branches. Our own sun has probably spent about a tenth of its lifetime in reaching its present stage. The bearing of the theory on the origin of the planets is briefly outlined. A. Hu.

2375. On sources of stellar energy—a criticism of the Bethe-Gamow theory. R. N. Rai. *Indian Journ. Phys.*, **14,** *pp.* 55–60, *Feb.*, 1940.—A review of the existing theories of energy production in white dwarfs and other stars has been made and it is shown that the existence of neutrons and high pressure due to the degenerate electron gas inside the white dwarfs may explain the low energy production in the white dwarfs.
Author.

2376. Galactic and extragalactic studies. Part VII. Magnitudes of 40 Cepheids in the large magellanic cloud. H. Shapley, V. McKibben and J. Mohr. *Nat. Acad. Sci., Proc.*, **26,** *pp.* 326–332, *May,* 1940.—With what appears to be a homogeneous system of magnitude standards the light curves of 40 classical Cepheids in the large magellanic cloud have been determined from estimates made on plates with the 24 in. Bruce refractor. The whole range of known periods, from 2·5 to 118 days, is represented, but special attention has been paid to stars with periods between 4 and 20 days. Light elements have been found for 6 of the variables, and the earlier values of the periods for the other 34 have been revised. Abnormally small amplitudes for 3 variables are attributed to the influence of close companion stars. Throughout intervals of median magnitude and period that include most of the classical Cepheids in the large cloud, the amplitude increases with period and therefore with absolute magnitude. The variation of the form of the mean light curve with the period is summarized. [See Abstract 1755 (1940).]

2377. The distribution of colour in spirals. C. K. Seyfert. *Astrophys. J.*, **91,** *pp.* 528–545, *June*, 1940.—This investigation is based on a photometric study of red- and blue-sensitive plates of the 7 spirals, NGC 598, 891, 2403, 3031, 4631, 5194 and 5457. The plates, calibrated by means of exposures with a tube sensitometer, have been measured in 2 photometers and by means of recording-microphotometer tracings across the principal axes of the spirals. These plates, taken with the Yerkes 24 in. reflecting telescope, have been supplemented by red-, yellow-, and blue-sensitive plates taken with the 82 in. reflector of the McDonald observatory and with a 6 in. refractor. The results show that the nebulous condensations in the arms of the spirals have red indices close to $0^{\mathrm{m}}.0$ and are considerably bluer than the spiral nuclei. The spirals appear to have a general background intensity which decreases smoothly outward from the nucleus and on which the arms seem to be superimposed. This background is of approximately the same colour as that of the nucleus. The colour of the arms alone is blue, of red index close to $0^{\mathrm{m}}.0$, and hence they are approximately of the same colour as that of the individual condensations. The colours of emission nebulae in the spirals is discussed, and the anomalies in the blue-yellow colour indices of emission nebulae suggest a rapid method of detecting such objects in extragalactic nebulae. Measures of the distribution of colour in 1 dark-lane spiral (NGC 891) give no indication of reddening within the dark lane. Author.

2378. Multiple variability of Delta Scuti. E. A. Fath. *Lick Observat., Bull. No.* 501, *pp.* 77–87, 1940.—Delta Scuti has 3 incommensurable periods of variation, $0^{\mathrm{d}}.193\,770$ $0^{\mathrm{d}}.0157\,382$ and $0^{\mathrm{d}}.095\,156$ with mean amplitudes of $0^{\mathrm{m}}.167$, $0^{\mathrm{m}}.033$ and $0^{\mathrm{m}}.011$, respectively. Besides these periods there appear for a time periods of approximately $0^{\mathrm{d}}.08$ and $0^{\mathrm{d}}.11$, but the latter do not persist throughout. There is also a certain amount of irregular variation superposed on these other variations. [See Abstract 5269 (1937).] Author.

See also Abstracts 2356, 2444.

SUN.

2379. The kinetic temperature of the solar reversing layer. P. J. Rubenstein. *Astrophys. J.*, **92,** *pp.* 114–118, *July*, 1940.—A redetermination of the curve of growth for the sun by means of least squares has resulted in a value of the temperature of the solar reversing layer for iron atoms and a value of the damping constant. Author.

2380. Atmospheric absorption of infra-red solar radiation at the Lowell Observatory. Parts III and IV. The spectral intervals: 8·0–11·0 μ and 11·0–14·0 μ. A. Adel and C. O. Lampland. *Astrophys. J.*, **91,** *pp.* 481–487, *June*, 1940.—The detailed transmission of the earth's atmosphere throughout the spectral intervals from 8·0 to 11·0 μ and from 11·0 to 14·0 μ is investigated empirically in its dependence upon water vapour, ozone and carbon dioxide. The transmission is given in both tabular and curve form for the following liquid water equivalents of atmospheric water vapour: (8·0–11·0 μ) 2·1, 3·2, 6·1, 10·8, 21·4, and 41·5 mm.; (11·0–14·0 μ) 1·3, 4·1, 6·5, 17·9, 20·3, and 23·3 mm. The integrated transmissions for these spectral regions are moderately high, being, in the region 8–11 μ, 83·6% for 2·1 mm. of water and 47·4% for 41·5 mm. of water; and, in the region 11–14 μ, 76·2% for 1·3 mm. of water and

49·3% for 23·2 mm. of water. This is in sharp contrast to the atmospheric transmission of the spectral region between 5·5 and 8μ, which, as shown in Part II [Abstract 390 (1940)], is merely 13% for 1 mm. of water and as little as 5% for 10 mm. of water. The absorption by atmospheric ozone, now correctly placed between 9 and 10μ, is much more intense than was formerly thought to be the case. The cessation of atmospheric transmission occurring normally at 13·9μ recedes to 13·5μ when the carbon dioxide in the path of the radiation has been increased to the amount resident in 2 or more air masses. Numerous small absorption lines due to water vapour have been recorded. Their existence has been established by repeated duplication. AUTHORS.

2381. On possible changes in the solar "constant". T. E. STERNE. *Observatory*, **63**, *pp*. 183–185, *July*, 1940.

See also Abstract 2392.

GEOPHYSICS.

GEODESY.

2382. On polar fluctuation and displacement. A. PREY. *Gerlands Beitr. z. Geophys.*, **56**, 2, *pp*. 155–202, 1940.—Assuming Chandler's fluctuation of the pole independent of the annual variation, a lower limit can be found for the viscosity of the earth of the order of 10^{22}. But it is generally assumed that the 2 variations are due to meteorological phenomena. In that case the viscosity must have a much lower value. An attempt is made to calculate the motion of the earth's axis assuming that the earth behaves hydrostatically under the influence of slowly varying forces, and that the earth's surface has a much higher rigidity and complete isostasy. The problem can be solved by elliptical integrals ; the integration leads to a period of 10 000 years. If, however, it is assumed that the terrestrial surface behaves like a liquid with the exception of a fraction of $\frac{1}{100}$, a period of 10^6 years is obtained which is compatible with the results of geological research. L. K.

HYDROSPHERE, PHYSICS OF THE.

2383. Tides in oceans bounded by meridians : Part IV. Series solutions in terms of angular width of ocean : semidiurnal tides in narrow oceans. Part V. Solutions by use of finite differences : semidiurnal tides. A. T. DOODSON. *Roy. Soc. Phil. Trans. A*, **238**, *pp*. 477–512, *Feb*. 29, 1940.—Previous work [Abstract 4421 (1938)] dealt with tides in oceans bounded by a complete meridian. Attention is here given to narrow oceans. There is a very marked stability of tidal régime as width of ocean increases. There are 2 amphidromic systems around points on the central meridian. For an ocean 50° wide the polar tides are direct and they remain so for an ocean of 70°, but they become indirect again for an ocean 90° wide. There are 2 ways in which polar tides may change from "indirect tides" to "direct tides". W. A. R.

LAND, PHYSICS OF THE.

2384. Temperature distribution within the earth in its semi-gaseous state. Parts I, II and III. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.*, **17**, *pp.* 525–537, *Sept.;* 675–684, *Dec.*, 1939, *and* **18**, *pp.* 27–40, *March*, 1940.—A mathematical discussion whence it is concluded that if the central temperature T of the primitive earth was (i) $< 4\,000°$ K. or (iii) $> 80\,000°$ K. that central part would be liquid; but if (ii) $5\,000° < T < 50\,000°$ it would remain gaseous. It is probable that (i) was the original state of the earth, showers of Fe and Ni being first formed on cooling. C. A. S.

2385. Note on the freezing of the soil. R. K. Schofield. *Roy. Meteorolog. Soc., J.*, **66**, *pp.* 167–170, *April*, 1940.—Soil temperatures under different conditions for the period 23 Dec. 1939 to 23 Feb. 1940 are compared. Temperatures below grass are approximately the same as those 4 in. deeper below bare soil, the grass covering reducing the effect of both atmospheric cold and warmth. The protective effect of snow is demonstrated. The mechanism of freezing of soil-contained water and the beneficial effect of frost on tilth is discussed. C. A. S.

***2386. Soil-moisture fluctuation under a lawn, as indicated by absorption from porous porcelain irrigator cones with continuous operation.** B. E. Livingston and S. B. Le Compte. *Am. Phil. Soc., Proc.*, **82**, 3, *pp.* 227–251, 1940.—After referring to various devices for the study of soil moisture in relation to plant performance the authors describe a new apparatus designed to study soil-moisture fluctuation in open ground. Observations were carried out in the summer of 1938 at Baltimore. The results showing the rates of water losses at different depths are represented graphically along with the corresponding records of precipitation and evaporation. It is found that after considerable rain the rate of loss near the surface falls to zero, this effect penetrating slowly downwards. On the other hand, while this decrease in loss is still continuing at the lower cones, absorption from the upper cones may again become quite marked. A. E. M. G.

2387. Velocity of elastic waves in a granular substance. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.*, **17**, *pp.* 783–807, *Dec.*, 1939. —Rounded grains of sand, rubber or lead, varying in size but uniform in any one experiment, were piled in various styles, either dry or wetted with water, paraffin or mizuame (rice jelly), and the velocity of longitudinal or torsional vibrations through the mass determined and the elastic constants deduced. The wave velocity through the granular mass varies as the $(\text{height})^{\frac{1}{4}}$, the ratio $(\text{Young's modulus} \div \text{density})^{\frac{1}{2}}$, and is also dependent on the style of packing, It is almost independent of the size of the grains. It is much less than through a solid block of the material of the grains and is decreased by increase of water content or porosity. [See Abstract 2354 (1938).] C. A. S.

2388. Plasticity conditions for formation of normal and reverse faults. Parts I and II. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.*, **17**, *pp.* 661–673, *Dec.*, 1939, *and* **18**, *pp.* 11–25, *March*, 1940.—The lastic stresses under gravitational forces produced in a spherical, cylinrical or plane, homogeneous earth are determined mathematically and the earing of these determinations on the production of normal and reverse aults discussed. The stresses and strains resulting in a surface block bounded by one original fault are determined mathematically, and the nature of the faults deduced. C. A. S.

2389. Studies in the sinking of the earth's surface in Tokyo. Part IV. Periodic movements of the ground in Hukagawa, Tokyo. N. MIYABE. *Tokyo Univ. Earthquake Research Inst., Bull.*, **18,** *pp.* 70–77, *March,* 1940.—An analysis of the observed periodic movements of the earth's surface at Hukagawa, Tokyo, shows that (1) the period of fluctuation is about 12 hrs.; (2) the amplitude of fluctuation varies with a period of about 15 days; (3) movements with approximate diurnal periods are of smaller amplitude than others, and much smaller than those anticipated from theory. This discrepancy may be attributable to the effect of atmospheric pressure. Assuming the value of Poisson's ratio of the soil to be 0·25, the value of Young's modulus of the soil is found to be 1 250 kg./cm^2.; this value is much greater than that derived from statical tests. The apparatus employed and deformation of the soil attributable to tides are briefly discussed. J. S. G. T.

METEOROLOGY.

2390. Calculation of the illumination from sun and sky. E. ELVEGÅRD AND G. SJÖSTEDT. *Gerlands Beitr. z. Geophys.*, **56,** 1, *pp.* 41–48, 1940.—The average illumination of a horizontal plane for different solar altitudes can be approximately calculated by the formulae $S = 1{\cdot}6 \sin h \times 10^{-0.1M}$ for solar illumination, $H = 0{\cdot}211\ V \sin h$ for the clear and $W = xS + yH$ for a cloudy sky, where x and y indicate the rate of radiation from the sun or the sky, which penetrates the clouds. The actual values of x and y depend on the character of the clouds. M is the mass of air through which the sunlight has passed, and h the altitude of the sun. The total illumination of a horizontal plane with a solar altitude of 45° has been chosen as unit. The formulae are in good agreement with the experimental results obtained by Aurén and Lunelund [see Abstract 1048 (1934)]. L. K.

2391. Results of a 1-year statistical survey of symmetry points. E. WAHL. *Gerlands Beitr. z. Geophys.*, **56,** 1, *pp.* 1–40, 1940.—The symmetry points of the barometric pressure have been calculated for 20 stations over the interval 1.6.1937–31.5.1938. A symmetry can only be recognized after a relatively long time interval. It is therefore necessary to exclude all symmetries which hold for less than 42 days. The probability for a correct prognosis for an interval of 3 days is estimated as 87%, and 76% if the interval extends over 6 days. But these results are valid only for those regions which possess symmetry points, i.e. between ⅔ to ¾ of the region covered by the weather map. L. K.

2392. Reports on critical studies of methods of long-range weather forecasting. *Monthly Weather Rev., Suppt. No.* 39, [130 *pp.*], *issued April,* 1940.

" Report on the work of Walker," by R. B. MONTGOMERY (*pp.* 1–22).—A critical survey of papers dealing with world weather including sunspot correlations, relationships between seasonal weather of different regions, the 3 oscillations and their numerical definitions, correlations of quarterly pressure and temperature, etc., non-contemporary corre tions with the southern oscillation and the secular variation. I concluded that the studies of the oscillations, especially the st persistence of the southern oscillation and of its influence in the north hemisphere, indicate that similar methods might lead to seaso forecasts of value for North America.

" Verification of 3 of Walker's seasonal forecasting formulae for Indian monsoon rain," by R. B. MONTGOMERY (*pp.* 23–24).—The tests have been brought up to 1936. It is considered that, in spite of the slight success attained by these formulae, an improved relation might be useful.

" Work of Savur of India," by R. B. MONTGOMERY (*pp.* 25–26).—The defects in Savur's treatment are stated.

" Polar ice as a factor in seasonal weather," by I. I. SCHELL (*pp.* 27–51).—Deals with relationships between sea ice and (1) the weather of adjacent regions, (2) world weather in accordance with Wiese's hypothesis and Walker's oscillations, (3) meteorological elements without reference to any particular scheme, and (4) relationships between icebergs and weather. The main results indicate a contemporary and subsequent relationship between ice in the polar seas of the northern hemisphere and the general circulation as indicated by the pressure distribution and other phenomena associated with it over the North Atlantic and Europe.

" Theories on temperature variations in the North Atlantic ocean and in the atmosphere," by R. B. MONTGOMERY (*pp.* 52–57).—Helland-Hansen's and Nansen's studies of the surface water and air temperatures and winds led them to conclude that anomalies are due to the local winds, and that the 2 temperature anomalies occur independently. The validity of these conclusions is criticized. The effect of later work by Simpson on the radiation balance is considered; the conclusions are essentially in agreement but a different interpretation is obtained.

" Summary of the methods used at the Scripps institution of oceanography," by R. B. MONTGOMERY (*pp.* 58–62).—McEwen and Gorton used sea water temperatures to forecast rainfall, and later air temperatures were also included. Methods were developed to forecast the monthly water and air temperatures 3 months in advance. The Hellmann and Bruckner cycles were also used. These methods are discussed and reasons given for the lack of success.

" Baur's contribution to long-range weather forecasting," by I. I. SCHELL (*pp.* 63–87).—The scheme is applied to forecast the weather for 10-day periods during the summer months, and the state of the preceding circulation is first used as an indication of subsequent weather. Next time-lag and contemporary relationships are derived and lastly a mathematical formulation of the relationships and their application is given. The physical basis of Baur's relationships is considered unsound and his use of correlations is criticized.

" Verification of Baur's 10-day forecasts," by L. F. PAGE AND P. F. CLAPP (*pp.* 88–91).—27 forecasts issued for spring and summer in the years 1933–6 were tested. These gave details of temperature, precipitation and sunshine, making 152 forecasts. These forecasts had little or no value after the first 5 days.

" Preliminary summary of the Multanoviski school of long-range weather forecasting," by I. I. SCHELL (*pp.* 92–96).—Composite maps based on synopsis considerations are prepared, ; 3 main groups of trajectories of anticyclonic centres are identified, having in general definite paths and following definite zones. The method used in constructing the composite map and its significance for any well-defined process are explained. A natural period time interval of a weather type is taken as 10–12 days, and a forecast can be issued after 2–3 days when the type has been identified. Certain phenomena or processes have a period of 30–35 days after the appearance of certain significant developments but 4 to 5 phases occur in the period. Asknazy's critical study of the method shows that the basic principles have a weak foundation for the forecasts, but Wangenheim shows that the forecasts for periods up to 2 weeks are much better. Willett criticizes the methods on the grounds of lack of clarity on the composite maps, difficulty of distinguishing clearly between weather types, the identification of phase changes in the 30–35 day period and the indefiniteness of the forecasts and verifications.

"Introduction to reports on variations of the solar constant as a factor in long-range weather forecasting," by L. F. Page (*p.* 97).—A brief summary is given of the earliest forecasts based on variations in the measured solar constant and the increased accuracy since attained in the measurement of this constant at the Smithsonian Astrophysical Observatory.

"Accuracy of Smithsonian Institution solar constant measurements," by H. G. MacPherson (*pp.* 98–117).—The long and short methods of deriving the corrections to solar constant measurements caused by absorption and scattering in the atmosphere are explained. Sources of error in the instruments themselves and the magnitude of errors in reading are discussed. Sources of error in the theory and method of calculation are considered with reference to infra-red and ultra-violet regions of the spectrum, the effects of ozone and changes of atmospheric transparency, and the possible variation of the solar constant during an observation.

"Comparison of contemporaneous measurements of the solar constant," by L. F. Page (*pp.* 118–120).—The opposing views of Abbot and Kimball regarding correlations between contemporaneous solar constant measurements at different stations are discussed.

"Statistical tests of solar constant and weather relationships," by L. F. Page (*pp.* 121–125).—Two theses are considered, (1) that periodicities in solar radiation are associated with those in weather data and (2) that certain patterns in temperature follow marked changes in the solar constant. Periodicities in observed values of the solar constant are examined; periodicities which occur in the sample of data cannot be expected to persist and are thus of no use in forecasting. There is no regular variation or consistent phase during an 11-year sunspot period. An analysis of Washington temperature data fails to fulfil any of the 4 criteria set up by Abbot for testing the hypothesis.

"Review of Clayton on long-range weather changes and methods of forecasting," by H. C. Willett (*pp.* 126–130).—Clayton's method is summarized. It is considered that the analysis of weather phenomena, involving pressure, temperature and precipitation, into pulses, waves or periods of different length is open to question and the basis for the forecast is doubtful. R. S. R.

2393. The ice storm of January 27-29, 1940. C. J. P. Cave. *Roy. Meteorolog. Soc., J.*, **66**, *pp.* 143–146, *April*, 1940.—The conditions of temperature and rainfall at Stoner Hill and other places in S. England during the period of ice formation, together with the effects produced, are described. Pressure distribution at the time indicated a cold front running S.E. across the Channel. A. E. M. G.

2394. Influence of the shore on the temperature and humidity of the atmosphere near the ground. B. H. C. Brunner. *Gerlands Beitr. z. Geophys.*, **56**, 2, *pp.* 113–154, 1940.—A complete account is given of the factors governing the exchange of heat near the ground in day-time. Horizontal convection and evaporation are determined. The observations show the variation of temperature and humidity of a maritime atmosphere near the ground at the coast line. The observations were carried out at a number of stations on the island Sylt. L. K.

2395. Weather and crops. B. A. KEEN. *Roy. Meteorolog. Soc., J.,* **66,** *pp.* 155–166, *April,* 1940.—Up to about 1922 two main lines of research were adopted, (*a*) an attempt to determine the existence of a cycle in weather phenomena with which would be associated a similar cycle in crop growth, (*b*) a statistical examination of the effect of different types of weather during or just before the growing period of the crop. As these methods proved insufficient a closer mathematical examination of crop-weather relations and a more intense study of plant-growth in relation to its environment were undertaken. The work done along both these lines is reviewed, and it is found that there is no immediate probability of a reliable prediction formula for crops in this country. But it must not be assumed that nothing can be done to improve methods of estimating yields. A scheme developed and tested for this purpose is outlined. A. E. M. G.

2396. Statistical determination of lunar daily variations in geomagnetic and meteorological elements. S. CHAPMAN AND J. C. P. MILLER. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4,** *pp.* 649–669, *May,* 1940.—These variations have been determined from series of hourly or bihourly values covering considerable periods. The mathematical theory underlying the method is given. The theoretical formulae expressed in terms of complex plane vectors are interpreted in real terms, and a brief outline is given of the actual computations. R. S. R.

See also Abstract 2380.

SEISMOLOGY.

2397. Dispersive Rayleigh waves of positive and negative orbital motion. K. SEZAWA AND K. KANAI. *Tokyo Univ. Earthquake Research Inst., Bull.,* **18,** *pp.* 1–10, *March,* 1940.—It is shown mathematically that the 2 kinds of dispersive Rayleigh waves [see Abstract 4181 (1935)] differ in the nature of their orbital motions; waves corresponding to the 1st and 2nd dispersive curves being transmitted with orbits of the opposite and the same sense, respectively, as those of gravitational waves. C. A. S.

2398. Elastic waves from a point in an isotropic heterogeneous sphere. Part II. R. YOSIYAMA. *Tokyo Univ. Earthquake Research Inst., Bull.,* **18,** *pp.* 41–56, *March,* 1940.—Waves propagated through a heterogeneous medium, in which the properties vary with the distance from the centre of symmetry, are discussed mathematically. [See Abstract 2907 (1933).] C. A. S.

2399. The deformation of the earth's surface that accompanied the Ogasima earthquake of May 1, 1939. N. MIYABE AND R. TAKEI. *Tokyo Univ. Earthquake Research Inst., Bull.,* **17,** *pp.* 646–649, *Sept.,* 1939.

2400. The Tunami that accompanied the Oga earthquake of May 1, 1939. F. KISHINOUYE AND K. IIDA. *Tokyo Univ. Earthquake Research Inst., Bull.,* **17,** *pp.* 733–740, *Dec.,* 1939.

***2401. Determination of ground periods.** W. D. PATTERSON. *Seismological Soc. of America, Bull.,* **30,** *pp.* 129–138, *April,* 1940.—The Neumann-Labarre and a vertical-component vibration meter, the Benioff 4-unit seismograph and a ground shaking machine, are described with examples of the vibrograms produced in different ways. So far, too many natural ground periods have been found to allow of the construction of a building whose periods would be out of resonance with the ground, but it might be possible to avoid the most important. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2402. The diurnal variation and vertical distribution of atmospheric condensation nuclei. E. A. YUNKER. *Terr. Mag.*, **45,** *pp.* 121–126, *June,* 1940.—The diurnal variation of the distribution of atmospheric condensation nuclei has been determined using a recording cloud-chamber apparatus. The results show an increase of nuclei-density with height in accordance with the suggestion of Gish and tentative vertical-density distribution curves are proposed. The studies give further support to the convective theory of diurnal variation suggested by previous work. The variation of nuclei-density with wind direction suggests a maritime origin for at least a portion of the nuclei. AUTHOR.

2403. The mobility spectrum of atmospheric ions. E. A. YUNKER. *Terr. Mag.*, **45,** *pp.* 127–132, *June,* 1940.—The mobility spectrum of atmospheric ions has been measured in the range of mobilities between 2·0 cm./sec./volt/cm. and 10^{-3} cm./sec./volt/cm. using a divided-electrode air-blast method. A continuous recording method was employed and the entire spectrum covered in about 1 hr. The spectrum shows the ordinary small ions, a group of ions at a mobility of about 0·5, and then a practically continuous distribution out to the lowest mobilities measured. The group having a mobility of 0·5 may be correlated with laboratory experiments of Chapman in which ions of this character were formed in the spray of dilute salt solutions. Simultaneous continuous measurements of the variation of density of condensation-nuclei lead to a lower limit for the size of the nuclei measured in the cloud-chamber of diameter $3 \cdot 3 \times 10^{-6}$ cm. AUTHOR.

2404. The atmospheric potential gradient at Poona, India. J. M. SIL AND K. S. AGARWALA. *Terr. Mag.*, **45,** *pp.* 139–144, *June,* 1940.

2405. The electrical characterization of days at Colaba (Bombay, India) during 1930-38. S. M. MUKHERJI AND A. R. PILLAI. *Terr. Mag.*, **45,** *pp.* 135–138, *June,* 1940.

2406. The local variation of atmospheric potential gradient during solar eclipse at Taihoku. K. OGASAHARA. *Gerlands Beitr. z. Geophys.*, **56,** 2, *pp.* 203–222, 1940.—The author compares the variations of the atmospheric electric field during 4 partial solar eclipses with the variations on normal days. The observations of the atmospheric potential gradient were carried out simultaneously with those of the meteorological factors (pressure, humidity, temperature and insolation). The results show that the fluctuations in the atmospheric electric field must be ascribed to the influence of the change in the meteorological conditions during the eclipse, and that the changes in the Heaviside layer do not affect the atmosphere near the earth's surface. L. K.

2407. On the contribution to the ionization at sea-level produced by the neutrons in the cosmic radiation. S. A. KORFF. *Terr. Mag.*, **45,** *pp.* 133–134, *June,* 1940.

2408. The vertical distribution of ionization in the upper atmosphere. C. L. PEKERIS. *Terr. Mag.*, **45,** *pp.* 205–211, *June,* 1940.—Some transformations are given of the de Groot-Appleton formula to facilitate its use for determining the distribution of ionization with height from equivalent-height data. The method is applied to data published by Appleton for noon conditions in England in April and May, 1933, and the results are shown. The scale-height in the F_2 layer on these days was of the order of 20 to 30 km. In the last section a formula is derived for determining the vertical distribution of electron-collision frequency from simultaneous measurements of the reflection coefficient as a function of frequency. AUTHOR.

2409. Total and uncharged nuclei at Washington, D.C. K. L. SHERMAN. *Terr. Mag.*, **45,** *pp.* 191–204, *June,* 1940.—The ratio (S) of the concentration of uncharged to that of all nuclei serves as a measure of the relative magnitude of the coefficients of combination and those of attachment between small ions and charged and uncharged nuclei, respectively, provided the assumptions usually made in this connection are valid. Diverse values of S have been found heretofore from the same data but by different methods. From 620 individual samples of both uncharged and total nuclei S was found to be 0·75 with a standard error of 0·02. This value of S is distinctly greater than that reported for other places but it is in close agreement with values previously determined at Washington with other equipment.

2410. Analysis of local atmospheric electric phenomena at College, Alaska. O. H. GISH AND K. L. SHERMAN. *Terr. Mag.*, **45,** *pp.* 173–190, *June,* 1940.—The atmospheric electric data obtained at College, Alaska, during the International Polar Year have been analysed in order (1) to separate the universal and local features in their diurnal variation and (2) to compare them with the theory of the electrode effect. After eliminating the universal diurnal variation from the potential gradient a local component remains. In winter this local component is largely the result of variations in the conductivity near the earth's surface, but in summer there is no correlation beween these elements. The calculated ratio of the columnar resistance of the air over College to that over the oceans shows a diurnal variation. The theory of the electrode effect is reviewed and amplified. Following the method of Scholz additional relations based on both the large- and small-ion theory are developed so that a variety of conditions are covered. AUTHORS.

See also Abstracts 2396, 2532.

RADIOACTIVITY.

2411. Study on radioactivity of hokutolite in Taiwan by means of a counter with linear amplifier. K. KIMURA. *Kyoto Coll. Sci., Mem.*, **23,** 1, *pp.* 7–17, 1940.—The hokutolite seems to have been formed by irregular sedimentation over long periods since the radioactivity, although measurable in the interior, is largely confined to the surface of the mineral. Most radioactive elements of the Ra series are present. F. C. C.

***2412. Counting instrument with linear amplifier.** K. KIMURA AND Y. UEMURA. *Kyoto Coll. Sci., Mem.*, **23,** 1, *pp.* 1–6, 1940.—Details and records of the linear amplifier used for examining the radioactivity of hokutolite [see previous Abstract]. F. C. C.

***2413. On the measurement of the radioactivity of water: suggestion of a new method.** G. Aliverti and G. Lovera. *Ricerca Scientifica,* **11,** *pp.* 235–243, *April,* 1940.—A method is described for distinguishing between, and measuring the quantities of, the various radioactive elements present in water. The method consists essentially of 2 parts, (1) the collection of radioactive deposit on an electrode, and (2) examination of the electrode in an ionization chamber. Full details are given and the errors and the sensitivity of the apparatus are discussed. E. E. W.

2414. Artificial radioactivity. Part V. R. Diebner and E. Grassmann. *Phys. Zeits.,* **41,** *pp.* 157–192, *April* 1, 1940.—Continuation of a report or summary of recent investigations on artificial radioactivity [Abstract 2475 (1939)]. The present part consists of the following chief divisions: artificial radioactivity caused (1) by He-^{3}He particles; (2) by α-particles; (3) by protons; (4) by deuterons; (5) by neutrons; (6) by X-rays and γ-rays. The review concludes with an extensive Bibliography up to Dec., 1939. J. J. S.

2415. Element 85 among the products of disintegration of radon. H. Hulubei and Y. Cauchois. *Comptes Rendus,* **210,** *pp.* 696–697, *May* 15, 1940.—A claim to priority as against Minder. [See Abstracts 3706 (1939) and 2095 (1940).] C. A. S.

2416. Effect of electric fields on the decomposition of nitrous oxide by α-rays. A. D. Kolumban and H. Essex. *J. Chem. Phys.,* **8,** *pp.* 450–454, *June,* 1940.—Ion yields expressed in molecules of gaseous products uncondensed by liquid air per ion pair are: 30°, no field 4·35, half-saturation 4·15, full saturation 4·61; 100°, no field 4·75, half-saturation 4·65, full saturation 5·76. If these results are interpreted on the assumption that ions are neutralized at the electrodes without decomposition it follows that, in the absence of an electric field, 9% of the reaction is initiated by combination of ions at 30°C. and 4% of the reaction is initiated at 100°C. The increase in ion yield at high field strength is probably due to electron collisions with molecules. As this occurs at field strengths at which the current/field-strength curve is horizontal, the new reaction is not initiated by ionization. Therefore, as the major part of the energy of α-rays remains in the primarily ejected electrons, electron collisions without ionization should initiate part of the reaction occurring in the absence of electric fields. Authors.

2417. A study of the nuclear radiations from Sb and As. A. C. G. Mitchell, L. M. Langer and P. W. McDaniel. *Phys. Rev.,* **57,** *pp.* 1107–1117, *June* 15, 1940.—Coincidences of β-γ and γ-γ were investigated in As^{76}, Sb^{122} and Sb^{124}. Measurements were made on the γ-ray energies by coincidence absorption of their Compton recoils. β-ray endpoints were determined by absorption in Al. In As the measurements indicate 3 groups of β-rays all going to excited states of Se^{76}. The endpoint of the highest energy group was found to be $3{\cdot}24 \pm 0{\cdot}20$ eMV. More than 1 γ-ray was found to be present. The hardest γ-ray has an energy of $2{\cdot}05 \pm 0{\cdot}05$ eMV. The effects due to Sb^{122} (2·5 days) and Sb^{124} (60 days) were separated. The β-ray spectrum of Sb^{124} was found to be simple, consisting of 1 group going to an excited state of Te^{124}. The endpoint of this group is $1{\cdot}53 \pm 0{\cdot}05$ eMV. More than 1 γ-ray was found. The highest energy γ-ray has an energy of $1{\cdot}82 \pm 0.05$ eMV. A soft γ-ray was also found having an energy less than 69 000 V. Evidence is offered which suggests the alternative process of K-electron capture with a transition to Sn^{124}. The β-ray spectrum of the short-period Sb^{122} was found to consist of 2 groups, 1 of which goes to the ground state of Te^{122}. The endpoint of the high-energy group was found to be 1·76 ± 0·10 eMV. The endpoint of the lower-energy group is estimated at 0·81 eMV. Only 1 γ-ray was observed. Its energy is 0·96 eMV. A self-consistent energy level scheme for Sb^{122} is given. Authors.

2418. Radiations from radioactive In (116). B. R. Curtis and J. R. Richardson. *Phys. Rev.*, **57,** *pp.* 1121–1124, *June* 15, 1940.—The energy of the γ-radiation emitted by In (116) with the 54-min. period has been studied with a large hydrogen-filled cloud chamber. The In was activated by slow neutrons from a cyclotron. The investigation used both the Compton recoil electrons from a carbon radiator of 35 mg./cm². surface density and the photo-electrons ejected from a lead sheet of 20 mg./cm². surface density. The recoil electrons from the carbon radiator indicate that the γ-radiation is complex and that the spectrum can be resolved into 3 lines of 1·02, 1·40, and 1·85 ± 0·05 eMV energy, the relative intensities of these lines being 1, 1, and ½, respectively. The momentum distribution of the photo-electrons emitted from the lead radiator indicates that there are 3 low-energy γ-ray lines. These lines have energies of 0·17, 0·36, and 0·57 ± 0·03 eMV and each has a relative intensity of about 1/7 compared with the 1·02 eMV line. The β-ray spectrum of the 54-min. period has been investigated and the upper limit of the energy found to be 0·84 ± 0·01 eMV. A measurement of the ratio of the β-rays to the γ-rays shows definitely that more than 1 quantum is emitted per electron. A level scheme is proposed which is in good agreement with all the data. Authors.

2419. Some improvements in a Geiger-Müller counting system. H. McMaster and M. L. Pool. *Rev. Sci. Instruments*, **11,** *pp.* 196–198, *June*, 1940.—A new method of interpolation is described which eliminates 1 tube per scale of 2 and does not disturb the equilibrium of the trigger tubes. A resolving time of 10^{-4} sec. was obtained with a quenching circuit incorporating the desirable features of both the Neher-Harper and the multivibrator circuits. Authors.

RADIATION.

ABSORPTION.

2420. Effects of pressure, temperature and chemical composition, on the absorption of light by mixtures of aromatic amines. R. E. Gibson and O. H. Loeffler. *Am. Chem. Soc., J.*, **62,** *pp.* 1324–1334, *June*, 1940. —The absorption of visible light by solutions of aromatic amines in nitro- or nitroso-compounds is pushed very significantly towards the longer wavelengths when the hydrostatic pressure over the solutions is raised at constant temperature, and also when the temperature is raised at constant volume. The absorption of light by these solutions may increase, decrease or remain constant, as the temperature is raised at constant pressure. These results are now correlated into a consistent theory which avoids any assumption of the formation of coloured compounds by the hypothesis that the colours of the solutions arise from the mutual polarizations of the molecules when appropriate groups are in close proximity, account being taken of the influence of pressure and temperature on the collision frequency, the distance of closest approach and the effect of short-range attractions between groups. It has also been shown that substituents in the nitro-compound and in the amine influence the absorption of light by the solutions in a way that parallels closely their effects on the reducibility of the NO_2 or NO group on the one hand, and the electron mobility in the amino-compounds on the other. It is suggested that the polarizations which give rise to the colours of the solutions may be regarded as primary steps in possible reactions, such as oxidation and reduction, involving transfer of electrons from the aromatic amine or hydrocarbon to the oxygen of the nitro- or nitroso-group. H. H. Ho.

2421. Computation of transmission factors of ultra-violet radiation through water. F. Benford. *J.O.S.A.*, **30,** *pp.* 133–135, *March,* 1940.—A mercury arc in a co-axial cylindrical quartz casing was immersed at one end of a 3·6 m. long tank of water and the radiation transmitted through various thicknesses of water was measured with a photocell mounted in a watertight case with quartz window. A simple direct method is given for determining the apparent solid angle of the arc as seen from the centre of the photocell. The formula obtained enables the transmission to be calculated for the path traversed between 2 positions of the photocell. The total transmission of a given thickness of water was obtained by extrapolation. W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

See Abstract 2431.

EMISSION.

2422. Wien's energy distribution law and optical pyrometry. D. C. Stockbarger. *J.O.S.A.*, **30,** *pp.* 224–225, *May,* 1940.—A simple experiment is described showing the relation between Wien's radiation law and the principle of the optical pyrometer and yielding a rough value for the second radiation constant c_2. W. S. S.

2423. Temperature radiation emissivities and emittances. A. G. Worthing. *J. of Applied Physics,* **11,** *pp.* 421–437, *June,* 1940.—The author reviews the different methods used in measuring the various temperature emissivities—normal and hemispherical, spectral and total, luminous and colour—of materials and the corresponding emittances of bodies. A table summarizing the results of measurements by various workers on the emissivities of some 15 metallic elements is included and attention is drawn to certain general tendencies which appear in existing data on emissivities. W. S. S.

2424. Latitude effect of cosmic ray showers. G. Occhialini. *Ricerca Scientifica,* **11,** *pp.* 231–234, *April,* 1940.—The variation in intensity of cosmic ray showers has been measured with a triple counter arrangement between Trieste and Bahia (Brazil). Although the corpuscular intensity varies by 10% owing to the latitude effect, the change in the shower radiation is remarkably small. This behaviour indicates that the shower-producing radiation differs little in quality or quantity over wide changes of latitude. F. C. C.

2425. Spread of cosmic radiation. B. Gross. *Pont. Acad. Sci., Acta*, **4**, 7, *pp.* 49–60, 1940. *In German.*—Continuing previous work [Abstract 2579 (1937)], a theoretical interpretation of the angular spread of cosmic radiation is attempted. After considering the results of a large number of workers it is concluded that the effect cannot be attributed to terrestrial influences but is inherent in the energy distribution of the primary radiation. F. C. C.

***2426. High-power tungsten light source.** H. Beutler and N. Metropolis. *J.O.S.A.*, **30,** *pp.* 115–117, *March*, 1940.—The source consisted of an incandescent tungsten ribbon of dimensions 3 in. × 0·02 in. × $\frac{1}{8}$ in. immersed in argon at atmospheric pressure. The high current required necessitated water cooling of the leads. The filament system was mounted in a pyrex bulb with tubular extensions carrying quartz windows for viewing the filament. The life of the filament was more than 50 hrs. Used with a grating spectrograph the lamp enabled exposures in the region of λ 3 400 to be reduced to 1/12 of those necessary with a conventional hydrogen discharge lamp (0·8 A, 5 000 V). W. S. S.

2427. Second maximum of the Rossi curve. A. K. Dutta. *Indian Journ. Phys.*, **14,** *pp.* 79–83, *Feb.*, 1940.—The second maximum of the Rossi curve, as observed by Schmeiser and Bothe with triple coincidence counting system, had not been observed by Nielsen, Morgan and Morgan with a fourfold counting system. They, therefore, consider that the second maximum is caused in some way by the background count. It is shown in the present work that, due to the geometrical configuration of the 3-fold and 4-fold counting systems, the countings in the 4-fold systems would be very much suppressed, specially those coming at a large angle with the vertical. Further, with a 4-fold coincidence the first maximum should fall more gradually than with a 3-fold counting system. These may cause a suppression and a masking of the second maximum, so that it has not been clearly observed with a 4-fold coincidence arrangement. Author.

See also Abstract 2407.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTER-GLOW.

2428. Photochemical studies. Part XXX. Fluorescence of diacetyl. General considerations on fluorescence. F. C. Henriques, Jr., and W. A. Noyes, Jr. *Am. Chem. Soc., J.*, **62,** *pp.* 1038–1043, *May*, 1940.—The correct use of intensity of radiation absorbed for fluorescence experiments is examined mathematically. The fluorescence of diacetyl as excited by 3 650 Å radiation was studied as a function of pressure (4 to 50 mm.), temperature (15° to 60°), and intensity; irradiation by 3 130 and 2 537 Å causes no measurable fluorescence. As the pressure of diacetyl increases, the quantum efficiency of fluorescence increases, indicating the apparent reverse of quenching. Fluorescence efficiency is independent of incident intensity but is enhanced by addition of acetone. The effect of temperature indicates an activation energy of about 1 200 cal. for the quenching process. Results can be explained by assuming that the state formed by absorption cannot fluoresce but is changed to other states which can fluoresce through the agency of collisions. N. M. B.

2429. Thermoluminescence of some common and unusual minerals. M. A. Northup and O. I. Lee. *J.O.S.A.*, **30,** *pp.* 206–223, *May*, 1940.—The authors examined qualitatively the thermoluminescence, triboluminescence, fluorescence and phosphorescence of over 100 minerals including many fluorites, calcites, apatites, lepidolites and feldspars. Thermoluminescence appeared to be most common in non-metallic, anhydrous, crystalline minerals, these characteristics together with a good cleavage favouring the production of triboluminescence. Tests on fluorites showed that their thermoluminescence is destroyed by brief heating to redness and is not restored by ultra-violet irradiation or, with one exception, by grinding (tribothermoluminescence). Evidence was obtained indicating the absence of any simple relation between thermoluminescence and the other forms of luminescence. Intensified thermoluminescence in 2 cases was associated with weak radioactivity, and in other cases with the presence of traces of Mn, Pb and Sn. W. S. S.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2430. Light intensity distribution in the spectrum produced by progressive supersonic waves in liquids. O. Nomoto. *Phys. Math. Soc. Japan, Proc.*, **22**, *pp.* 314–320, *April*, 1940. *In German.*—The photographic method of measurement is described and the results discussed and compared with Raman's theory. Light of $\lambda = 5461$ Å was normally incident on the surface of transformer oil on which supersonic waves ($\lambda = 0{\cdot}0505$ cm.) were generated.

2431. Dark bands in the spectra of double diffraction gratings. R. A. Houstoun. *Phil. Mag.*, **30**, *pp.* 68–78, *July*, 1940.—When electric oscillations set up ultrasonic vibrations in a quartz plate they convert it into a diffraction grating. Examination of the spectrum of monochromatic light that has passed twice through such a grating shows the image of the slit to be covered by black bands parallel to its edge. These bands have already been observed with optical diffraction gratings. The explanation of the bands is discussed at length. A. H.

2432. Light scattering in normal human dentine. The calculation of absorption and scattering constants. R. S. Manly, J. F. Bonner and H. C. Hodge. *J. Phys. Chem.*, **44**, *pp.* 745–751, *June*, 1940.—The empirical equation of Bloch and Renwick has been found to hold for the relation between transparency and thickness of normal dentine. Absorption and scattering constants were calculated from the theoretical relation of Channon, Renwick and Storr. The coefficient of scattering (9·0) for normal dentine is about 300 times the absorption coefficient (0·03). In transparent dentine, which has partially calcified tubules and consequently less scattering surface, the scattering coefficient is $\frac{1}{20}$ that of normal dentine; the absorption constant, however, is not changed. Authors.

See also Abstract 2449.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2433. The photolysis of methylethyl ketone. W. J. Moore, Jr., and H. S. Taylor. *J. Chem. Phys.*, **8**, *pp.* 466–467, *June*, 1940.—The nature of the products from the photochemical decomposition of methylethyl ketone at temperatures from 90 to 200° has been re-examined. In contrast with earlier results the formation of ethane, propane and butane, parallels the frequency of the corresponding free radical collisions. At the higher temperatures, however, production of ethane and especially of methane becomes predominant. The influences on the product distribution of secondary reactions, the lifetimes of the free radical collision complexes and the activation energies and entropies, are considered. Authors.

PHOTOMETRY.

*** 2434. A simplified high-sensitivity photometer or exposure meter for photographic enlarging.** W. VAN B. ROBERTS. *Rev. Sci. Instruments*, **11**, *pp*. 159–160, *May*, 1940.—An instrument of the type in which an emission photocell is connected in circuit with a condenser, a valve amplifier and a telephone, so that the rate of clicking in the telephone is a measure of the light falling on the cell. J. W. T. W.

2435. Interreflections. P. MOON. *J.O.S.A.*, **30**, *pp*. 195–205, *May*, 1940.—The determination of the resultant luminosity of the diffusely reflecting walls of an enclosure has been shown by Buckley and others to reduce to the solution of an integral equation. The author extends the theory by applying to the solution of the integral equation the method of eigen-values and eigen-functions developed by Hilbert and Schmidt. Enclosures of simple form are first considered and an exact solution is then obtained for the infinite circular cylinder with a longitudinal strip removed. W. S. S.

See also Abstract 2423.

POLARIZATION.

*** 2436. Simplified half-shadow compensator.** G. SZIVESSY AND W. HERZOG. *Zeits. f. Instrumentenk.*, **60**, *pp*. 97–107, *April*, 1940.—[See Abstract 2129 (1940).] It is shown that, for a given phase difference of the compensating plate, the sensitivity increases the more the nearer to 90° the angle between the direction of vibration of the analyser and the major axis of the ellipse of vibration. The application to the determination of the retardation of a parallel birefringent plate is described. L. K.

2437. Optical activity, circular dichroism and absorption, of crystalline nickel sulphate. L. R. INGERSOLL, P. RUDNICK, F. G. SLACK AND N. UNDERWOOD. *Phys. Rev.*, **57**, *pp*. 1145–1153, *June* 15, 1940.—Previous measurements of the optical rotatory power of crystalline $\alpha - \mathrm{NiSO_4 \cdot 6H_2O}$ in the visible spectrum have now been extended to cover the wavelength range from $0{\cdot}25\mu$ to $2{\cdot}2\mu$. Circular dichroism and absorption measurements have also been made over the infra-red range. Striking anomalies in the rotatory dispersion curve appear at $0{\cdot}69\mu$ and particularly at $1{\cdot}16\mu$, corresponding to absorption and circular dichroism maxima at these wavelengths. The theoretical relation between rotatory power and dichroism is verified quite exactly and in detail, particularly with regard to the $1{\cdot}16\mu$ band. AUTHORS.

See also Abstract 2449.

REFLECTION, REFRACTION AND DISPERSION.

*** 2438. Measurement of reflecting power of minerals in translucent specimens.** E. ABBOLITO. *Ricerca Scientifica*, **11**, *pp*. 252–255, *April*, 1940.—A simple method is described, using a photo-element and a galvanometer. L. E. F.

2439. The optics of decentralized systems. H. SCHULZ. *Zeits. f. techn. Physik*, **21**, 1, *pp*. 15–16, 1940.—Formulae for the positions of the principal planes and the magnitudes of the focal lengths for a system of 2 lenses inclined to each other are obtained. The focal lengths on the object and image sides of the system are shown to be different. G. O. B.

2440. Determination of the refractive index of Fe. A. BOETTCHER. *Ann. d. Physik*, **37**, 4, *pp*. 278–290, *April*, 1940.—The author has determined the refractive index of Fe for the wavelengths 578 $m\mu$, 546 $m\mu$ and 435 $m\mu$, by means of Kundt's method. The prisms were obtained by h.f. evaporation *in vacuo* and a rotating sector ensured plane prism surfaces. A photographic method was used for the measurements of the angle of refraction and the angle of deviation. L. K.

2441. Optical constants of thick metal films in the visible and near infra-red region. R. Kretzmann. *Ann. d. Physik,* **37,** 4, *pp.* 303–325, *April,* 1940.—The metal films for the measurement of the optical constants were obtained by evaporation *in vacuo*. The thickness of the layers varied between 200 and 400 $m\mu$. The polarization of the reflected light was observed photo-electrically, and the optical constants were calculated for Cu, Ag and Au for the wavelength region 5 000–10 000 Å. The values of the optical constants were found to depend on the evaporation time of the mirrors; this influence is greatest for Cu and negligible for Au. The dispersion of the mirrors was independent of the substrate (glass or quartz) on which the metals were deposited. L. K.

***2442. Condenser for projection apparatus.** H. Schulz. *Zeits. f. techn. Physik,* **21,** 2, *pp.* 34–35, 1940.—Formulae are given for the focal lengths and lens intervals of a 3-lens condenser for a projection apparatus. The formulae show the dependence of the lens constants on the given image and object distances and on the magnification. G. O. B.

See also Abstracts 2435, 2488.

SPECTROSCOPY.

2443. Energy calibration of a monochromator with a high-pressure Hg lamp. F. Rössler. *Zeits. f. techn. Physik,* **21,** 1, *pp.* 18–22, 1940.—The effect of the width of the slit of a monochromator has been investigated and its effects on the line and continuous spectra of the ultra-violet radiation from a Hg high-pressure lamp have been discussed. Rules for the setting up of a suitable slit are given. A method of calibrating a monochromator by means of this radiation, without error, using 3 standard lines, is fully described and illustrated by a numerical example. G. O. B.

2444. Absolute *f*-values by the method of total absorption. R. B. King and D. C. Stockbarger. *Mt. Wilson Observat., Contrib. No.* 629. *Astrophys. J.,* **91,** *pp.* 488–502, *June,* 1940.—A special furnace has been constructed for the purpose of measuring the absolute *f*-values of lines in spectra of astrophysical interest. The method, that of total absorption, is described and results obtained in the course of the preliminary work are given. For the line λ 3 261 of Cd an *f*-value of 0·002 3 was obtained, in good agreement with the values obtained by other investigators. For the Cu resonance lines $\lambda\lambda$ 3 247 and 3 274 the results are 0·62 and 0·32, respectively. Authors.

2445. Secondary K-absorption edges of Co salts in solid and liquid solutions. B. B. Ray, S. R. Das and N. Bagchi. *Indian Journ. Phys.,* **14,** *pp.* 37–54, *Feb.,* 1940.—The paper deals with the experimental measurements on the primary and secondary *K*-absorption edges of Co metal, its oxides and its components, both in the forms of solid and solutions. It is found that (*a*) though the primary *K*-edge of Co shifts to the shorter wavelength side of the spectrum as one passes from the metallic form of the element to its compounds, the secondary structures of all the solid compounds show a similarity with that of the metal itself; (*b*) the similarity between the structures in Co metal and that in anhydrous cobaltous chloride is significant. Though both these substances form hexagonal crystals, the metallic Co is non-ionic while the other is of the ionic type; (*c*) CoO and Co_2O_3 (cubic and hexagonal respectively) show the same type of structures; (*d*) near the *K*-absorption edge the relative intensity of the structures (i.e. contrast between the white and dark lines) is quite prominent, and it decreases at first with increasing separation from the main edge, and afterwards increases again before it vanishes; (*e*) on passing from the solid polar compounds to solutions up to 1 *N* the similarity of the secondary structures in all cases is noteworthy. It is suggested that in solutions up to 1 *N* most of the molecules are not dissociated; (*f*) in the cases of dilute solutions of strengths of the order of *N*/10 and *N*/20 the structure near the primary is quite different from what has been observed with strong solutions (*e*); here it is suggested that only a small percentage of the molecules are dissociated; the positions of the secondary structures show that they originate from undissociated molecules; (*g*) the solution of $Co(NO_3)_2 \cdot 6H_2O$ in conc. HNO_3 shows the same structure as is exhibited by strong solution of the same substance in water (*e*). AUTHORS.

2446. On the width of the K-absorption edge of Co. N. BAGCHI. *Indian Journn. Phys.*, **14**, *pp*. 61–65, *Feb.*, 1940.—The width of the *K*-absorption edge of cobalt metal and the compounds CoO; Co_2O_3; $Co(NO_3)_2$, $6H_2O$; $CoSO_4$, $7H_2O$; $CoCl_2$ (anhydrous); $CoCl_2$, $6H_2O$ in the solid form and in aqueous solutions of $CoSO_4$, $7H_2O$; $CoCl_2$, $6H_2O$ and $Co(NO_3)_2$, $6H_2O$ having different strengths together with a concentrated solution of cobalt in nitrate acid has been studied. So far as the compounds of Co in the solid states are concerned the pure metallic element shows the largest width, whereas in solid metallic compounds and their aqueous solutions the solid has the smallest width. The width of the edge in a concentrated solution of cobalt nitrate in nitric acid deserves particular attention as it is not only appreciably larger than the same obtained in the solid nitrate and in its aqueous solutions but is the largest obtained in this set of investigations. In the case of metallic element and blue oxide CoO neither the inflection point, which determines the wavelength of the edge, nor the full width or the idealized width, is affected by the screen thickness. The presence of structure edge *K′* is also reported in the case of cobalt metal and its black oxide Co_2O_3. AUTHOR.

2447. Spark spectrum of silver. E. RASMUSSEN. *Phys. Rev.*, **57**, *pp*. 840–841, *May* 1, 1940.—With a hollow cathode of pure silver in a neon discharge a number of new spectral lines are observed comparable in intensity to the strongest silver arc lines. It is shown that all of the strong lines, and some of the weaker lines, can be classified as combinations between the well known group of 12 odd terms arising from the $4d^95p$ configuration of the silver ion and 5 higher even terms not so far encountered. It is believed that the $4d^85s^2$ configuration is responsible for the new levels. The enhancement of the lines is explained by a resonance effect of collisions of the second kind between neon ions and silver atoms. A. H.

2448. Arc spectrum of silver. A. G. SHENSTONE. *Phys. Rev.*, **57**, *pp*. 894–898, *May* 15, 1940.—A re-examination of the arc spectrum of silver is made and a list is given of all the lines (between 40 000 and 1 250 Å) which can safely be attributed to AgI. There are 243 lines of which 148 are new. The classification of the lines is discussed at length and attention is drawn to the extreme width of many of the silver arc lines. A. H.

2449. Splitting of spectral lines at scattering by liquids. S. M. MITRA. *Indian Journ. Phys.*, **14**, *pp*. 1–11, *Feb.*, 1940.—The fine structure of the Rayleigh line due to the molecular scattering in liquids has been investigated with a F. P. etalon and the 2 fine-structure components are identified, the higher component reported by Gross being absent. The question of the reality of the red shift of the Rayleigh line observed by Cabannes and his co-workers with a F. P. etalon has also been examined and it is shown that there is no such red shift. The observed values of the shifts of the displaced components from the central ones were always found to be greater than the values calculated from Brillouin's equation. The dependence of the frequency shifts of the split components from the central main-lines on the following has also been investigated :—(*a*) the frequency of the incident light, (*b*) angle of the scattering. The influence of temperature on the split components has been examined and it is found that the split components become fainter and broader, gradually merging with the central undisplaced components, as the temperature on the liquid is raised. The intensity of the central components is gradually increased. On the other hand, opposite effects were observed on lowering the temperature of the liquid. The state of polarization of the 3 components was examined. The results indicate that all of them are completely polarized. AUTHOR.

2450. On the absorption spectra of polynuclear complex salts. Y. OHYAGI. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 186–195, *May*, 1940.—The spectra were observed in phosphoric acid solution. They are stable and give distinct absorption spectra. AUTHOR.

2451. Spectroscopic evidence for hydrogen bonds : the hexyl alcohols. S. C. STANFORD AND W. GORDY. *Am. Chem. Soc., J.*, **62**, *pp.* 1247–1251, *May*, 1940.—The infra-red absorption spectra in the 3μ region were determined for 8 hexyl alcohols and for their solutions in CCl_4. Transmission curves for the liquids and molecular extinction curves for the solutions are plotted. From the behaviour of the OH band of the alcohols on dilution in CCl_4 deductions on the nature of association are reported and differences in behaviour of the alcohols are interpreted in terms of the structural environment of the OH group. N. M. B.

2452. Note on the infra-red absorption spectra of the vapours of DCOOH and DCOOD. R. C. HERMAN AND V. WILLIAMS. *J. Chem. Phys.*, **8**, *pp.* 447–449, *June*, 1940.

2453. Intensities in molecular electronic spectra. Part X. Calculations on mixed-halogen, hydrogen halide, alkyl halide and hydroxyl spectra. R. S. MULLIKEN. *J. Chem. Phys.*, **8**, *pp.* 382–395, *May*, 1940.—The dipole strengths for certain perpendicular-type transitions $N \rightarrow Q$ are calculated by the *LCAO* and *AO* approximations and show satisfactory agreement with experimental values obtained from a critical examination of the scanty available absorption-coefficient data. The iodides, as for I_2, show anomalously low strengths for the true $N \rightarrow Q$ part of the intensity ($N \rightarrow {}^3\Pi_1$ and $N \rightarrow {}^1\Pi$) with high strength for $N \rightarrow {}^3\Pi_{0^+}$. These anomalies are ascribed, as in I_2, to partial case *c* coupling. The comparison of theory and experiment confirms the interpretation of the ultra-violet continua of the H and alkyl halides as $N \rightarrow Q$ transitions. Dipole strengths are calculated for the ${}^2\Sigma \rightarrow {}^2\Pi$ transition in OH [see Abstract 3726 (1938)]. A general equation for the $N \rightarrow Q$ dipole strength in AX or OH is obtained covering any degree of ionicity and of polarity. The magnitudes of overlapping and dipole-strength integrals in relation to molecular stability and to principal quantum number of the valence orbital are discussed. [See Abstract 1844 (1940).] N. M. B.

2454. Far ultra-violet absorption spectra of some aliphatic ketones. A. B. F. DUNCAN. *J. Chem. Phys.*, **8**, *pp.* 444–446, *June*, 1940.—Absorption spectra of methyl *n*-propyl, methyl isopropyl and diethyl ketones between 2 000 and 1 500 Å were found. The electronic transitions and their vibrational structure are discussed in comparison with acetone and methyl ethyl ketone. It is concluded that most transitions are probably of a Rydberg type, leading to ionization potentials in the neighbourhood of 10 eV. AUTHOR.

2455. Light absorption in simple aromatic compounds. K. F. HERZFELD. *Am. Phil. Soc., Proc.*, **82,** 3, *pp.* 359–367, 1940.—A simple account of current quantitative explanations of the ultra-violet absorption spectra of benzene and of some of its simpler derivatives. C. B. A.

2456. Note on the ultra-violet absorption systems of benzene vapour. G. NORDHEIM, H. SPONER AND E. TELLER. *J. Chem. Phys.*, **8,** *pp.* 455–458, *June*, 1940.—The following assignments are proposed : A forbidden transition of symmetry ${}^1A_{1g} \to {}^1B_{1u}$ is suggested for the bands at 2 050 to 1 850 Å and an allowed ${}^1A_{1g} \to {}^1E_{1u}$ transition for the much more intense bands at 1 850 to 1 650 Å. The continuous background in the latter region may possibly be due to a transition involving a C — H dissociation. The observed 2 Rydberg series can both be assigned to allowed transitions of symmetry ${}^1A_{1g} \to {}^1E^-_u$. AUTHORS.

2457. Spectroscopic measurements of gaseous CN. Part II. Thermal dissociation of cyanogen. J. U. WHITE. *J. Chem. Phys.*, **8,** *pp.* 459–465, *June*, 1940.—[See Abstract 770 (1940).] Free CN radicals are formed from cyanogen at high temperature. Their absorption spectrum was observed in a furnace at 1 500°K. From the lower point of the absolute absorption coefficient found in Part I of this paper their partial pressure and hence the equilibrium constant of the dissociation of cyanogen to free radicals are calculated. A lower limit for the heat of the reaction $C_2N_2 \to 2CN$ $K_{1500°K} = 1\cdot1 \times 10^{-12}$ $H_0 = 138\cdot1\ (\pm 1)$ kcal. follows directly. $f = 0\cdot1$ is estimated to be the most probable f value for the ${}^2\Sigma \to {}^2\Sigma$ transition of CN. The most probable value of the heat of dissociation of cyanogen is calculated from this to be $H_0 = 146\ (\pm\ 4)$ kcal. By calculating the partial pressure of CN at about 400°C., the thermal polymerization of cyanogen is explained as the addition of the free radicals formed to cyanogen molecules. From thermodynamic cycles it is shown that the most probable value of the heat of dissociation of CO is 11·054 V, and of the heat of vaporization of graphite 169·2 kcal., although 9·797 V and 140·2 kcal., respectively, for these values cannot be completely eliminated. AUTHOR.

2458. The rotatory dispersion and circular dichroism of 1-menthyl d-β-chloro-β-nitrosobutyrate. S. MITCHELL AND G. K. SIMPSON. *Chem. Soc., J.*, *pp.* 784–787, *June*, 1940.—When molecular extinction coefficients and circular dichroism are plotted against wavelength, the curves obtained are very similar in form and each can be represented as the sum of 2 probability curves. The anisotropy factors found from the corresponding component curves have the same maximum value. Using Lowry and Hudson's modification of an equation formulated by Kuhn, partial rotations from the 2 circular dichroism components are calculated, and when the sum of these is subtracted from the experimental rotation curve a difference curve is obtained in which the anomaly due to the nitroso-group is completely smoothed out. AUTHORS.

2459. Potential function of acetylene molecule. Part II. TA-YOU WU. *J. Chem. Phys.*, **8,** *pp.* 489–494, *June*, 1940.—From a study of the interaction between the vibration and the rotation the convergence factor of the rotational lines of the vibration-rotational bands of C_2H_2 is obtained as a function of the various vibrational quantum numbers and the constants in the first-order anharmonic potential. A tentative calculation of the first- and second-order anharmonic potentials is carried out for the C_2H_2 molecule on the basis of the classification of the absorption bands given in Part I. [See Abstract 1685 (1939).] AUTHOR.

2460. Radiation measurements of hot flame gases with a Cs photocell. R. MECKE AND H. KEMPTER. *Zeits. f. techn. Physik*, **21**, 4, *pp*. 85–88, 1940.—In an investigation of the spectral radiation of the hot gases (water vapour) from a bunsen flame with a monochromator it is shown that a Cs photocell and a valve voltmeter are superior as a recording apparatus to the photographic plate down to a temperature of 1000°K. A small Osram lamp was used as a comparison light source. G. O. B.

2461. Hindered rotation in methyl alcohol. J. S. KOEHLER AND D. M. DENNISON. *Phys. Rev.*, **57**, *pp*. 1006–1021, *June* 1, 1940.—The problem is examined mathematically in relation to a model in which a rigid OH bar may rotate about the axis of a rigid pyramid representing the CH_3 group under the action of a hindering potential. The wave equation is split into a Mathieu equation governing the internal motion and a symmetrical rotator equation describing the rotation of the whole molecule. The behaviour of the energy levels as the potential barrier height is raised from 0 to ∞ is treated qualitatively and an exact method of calculating energy levels, wave functions and transition probabilities, is devised. It is shown that the levels lying well below the barrier (vibrational levels) are each split into 3 components whose spread depends on the penetrability of the barrier. Levels lying above the barrier rapidly take on the character of states found in free rotation. Calculations of the levels and of the resulting spectrum are made with a barrier height of 770 cm^{-1}., and the theoretical spectrum appears to be in agreement with available data but the barrier height is probably about 470 ± 40 cm^{-1}. N. M. B.

See also Abstract 2380.

TRANSMISSION.

See Abstract 2339.

VISION.

2462. Theory of visual threshold. Part II. Kinetics of adaptation. W. J. CROZIER. *Nat. Acad. Sci., Proc.*, **26**, *pp*. 334–339, *May*, 1940.—The kinetics of dark adaptation, as expressed in the change of intensity threshold with dark time, displays the statistical result of fluctuating recovery of excitability as regards the elements of neural effect produced from excited units with variable thresholds. The form of the dark adaptation contour does not reveal the physiochemical nature of the metabolic process governing receptor excitation. It is simply a Gaussian probability integral in which $1/\Delta I_0$ is the ordinate and log (dark-time) is abscissa. This can be arrived at deductively. The behaviour of its 3 parameters (maximum $[1/\Delta I_0]$; abscissa of inflection; standard deviation of the first derivative) under different experimental conditions of adaptation and of its testing, in various animals, is in accord with this. [For Part I see Abstract 1581 (1940).] AUTHOR.

2463. Induced size effect. K. N. OGLE. *J.O.S.A.*, **30**, *pp*. 145–151, *April*, 1940.—Inequalities in the ocular images produced by the 2 eyes (aniseiconia) lead to distortions of binocularly perceived space. These distortions can be artificially induced by placing over one eye a size lens which for a given object position changes the object size without altering its distance. The results of investigations by this method are given in the paper. If the size lens is designed and worn so as to modify only the horizontal dimensions of objects seen by the eye, the effect on binocular vision is an apparent rotation of space about a vertical axis. The effect is readily explained on the accepted principles of stereoscopic vision and the experimental observations bear out the theory. If, however, the size lens is worn so as to modify only the vertical dimensions of objects, there is again an apparent rotation about a vertical axis but in the reverse sense to that previously obtained. This is the so-called induced size effect for which no simple geometric or functional explanation can be suggested. The measurements show that for the induced effect the relation between the apparent rotation and the magnification of the size lens is not simple proportionality and the form of the relation may prove valuable in the diagnosis of aniseiconia. W. S. S.

2464. Aniseiconia. G. H. GLIDDON. *J.O.S.A.*, **30,** *pp.* 142–144, *April,* 1940.—Aniseiconia or the condition in which the ocular images of an object are unequal in size and/or shape is described and the beneficial effects obtained by its correction with suitable glasses are indicated. Aniseiconia causes a conflict between the space localization of monocular vision based on perspective and that of binocular vision based on the disparity of the 2 ocular images. This conflict may lead to nervous symptoms and it may account for certain difficulties in driving and flying. W. S. S.

X-RAYS.

2465. X-ray investigation of the system Cr_2O_3-NiO. L. THOMASSEN. *Am. Chem. Soc., J.*, **62,** *pp.* 1134–1136, *May,* 1940.—In an investigation of the phases found in the system and identified by the X-ray diffraction patterns the equilibrium diagram showed that the spinel type structure $NiO \cdot Cr_2O_3$ is the only compound present. At 1000° solubility of NiO and Cr_2O_3 in the spinel is small. NiO does not dissolve Cr_2O_3. N. M. B.

2466. An improved technique for mounting powdered samples for X-ray diffraction. J. S. LUKESH. *Rev. Sci. Instruments,* **11,** *pp.* 200–201, *June,* 1940.—A method of preparing samples for X-ray powder photographs is described by which the material under test is powdered in the usual way, made into a paste with a suitable binder such as ordinary paste or collodion, and then extruded from a fine hole in the form of a thread of about $\frac{1}{2}$ mm. diameter. G. O. B.

2467. A comparative X-ray diffraction study of several natural apatites and the apatite-like constituent of bone and tooth substance. W. F. BALE. *Am. J. of Roentgenology and Radium Therapy,* **43,** *pp.* 735–747, *May,* 1940.—Experiments described show that the cells of bone, tooth enamel, dentine, hydroxyl-apatite and tricalcium phosphate hydrate, are identical and that the portion of the tooth and bone tissue responsible for their characteristic diffraction pattern approximates to the structure of hydroxyl-apatite. It is concluded that there is lack of homogeneity in bone and tooth substance and that the carbonate in these substances does not form an integral part of the apatite lattice, but is present mostly at boundary and transition regions in the lattice where the apatite structure is imperfectly developed. B. J. L.

2468. Differential radiography. W. WATSON. *Radiography,* **5,** *pp.* 81–88, *June,* 1939.—The term " differential " is applied to all systems which produce a shadow or radiograph in which there is a distinct difference between one particular plane and the remaining planes of an object. In practice the shadow of a plane cannot be realized, so that the difference obtained is between a number of planes (forming a layer or section) and the remainder. Of the 2 methods by which such effects are produced, one is instantaneous while the other is accumulative. An instantaneous difference is dependent on the blur inseparable from the use of a non-point source of X-rays and is intentional when the X-ray tube is placed in contact with the object, the plane nearest the film then being rendered the sharpest, the definition decreasing with increased distance from the film. Accumulative methods depend on a factor of time, angle, or transit, the image of a selected plane being allowed to accumulate over a period of time during which the images of other planes are transitional relative to the film. Methods of accomplishing this are described in principle and some simple practical devices in more detail, with illustrations of the results obtainable with them. A. W.

See also Abstract

1537B. X-rays and γ-rays as mutation factors. J. P. Lamarque.

HEAT.

CONDUCTION.

2469. Heat flow in a bar whose parameters depend on the co-ordinates. Application to the temperature uniformity of a metal object in air. P. VERNOTTE. *Comptes Rendus*, **210,** *pp.* 664–666, *May* 6, 1940.—Attention is directed towards finding an approximate method of calculating the temperature differences set up in a metallic case when used as a thermostatically controlled enclosure under conditions where the heat losses from its surface are not constant but may vary from point to point. The resultant formula is $12\ \delta V = TH\,pl^2/ks$, where p is the perimeter of the surface from which convection can take place, l the height of the box, k the thermal conductivity of the metal and s the cross-sectional area through which heat flows. δV is the maximum temperature difference in the thermostatically controlled box, T the temperature difference between the box and the air, and H the variation δh of the coefficient of convection along the length of the box in the case where the thermostat is internally controlled, or H is the coefficient of convection at the mid-height and T the variation $\delta\theta$ of the temperature of the air from the top to bottom of the box. R. W. P.

2470. The similarity law in heat theory. E. F. M. VAN DER HELD. *Zeits. f. techn. Physik*, **21,** 4, *pp.* 79–85, 1940.—The importance of the similarity principle in physics is indicated, by which problems are solved by the consideration of reduced scale models. It is shown that to each problem there belong certain dimensionless magnitudes which always appear together in mathematical expressions. In particular, in the theory of heat the following numbers or magnitudes occur for which expressions are given : the numbers of Fourier and Nusselt, of Reynolds, of Pielet, of Grashof, of Prandtl and of Lewis. The use of some of these numbers in the theory of the *schlieren* photographic process is discussed. G. O. B.

DILATATION.

2471. The effect of alumina on the expansion and deformation temperatures of soda-lime-silica glasses. W. B. Silverman. *Soc. Glass Technol., J.*, **24**, *pp.* 59–72, *April*, 1940.—The coefficients of expansion between 80° and 170° and the deformation points of a systematic series of soda-lime-alumina-silica glasses as measured by the interferometer method are presented. The range of composition covered extends from 11 to 19% Na_2O, 6 to 16% CaO, 0 to 8% Al_2O_3, and 59 to 79% SiO_2. Author.

***2472. Apparatus for precision measurement of dilatation.** K. H. Fischer. *Zeits. f. Instrumentenk.*, **59**, *pp.* 341–357, *Sept., and pp.* 385–396, *Oct.*, 1939.—A description is given of a dilatometer arrangement for samples of solids. A new contact thermometer relay is discussed in detail and calibration methods are described. Some results are given.

TEMPERATURE.

2473. Temperature and temperature scales. H. T. Wensel. *J. of Applied Physics.*, **11**, *pp.* 373–387, *June*, 1940.—The fundamental concepts are developed, the basis and significance of a thermodynamic scale are discussed, and the relation of various practical scales, in particular the International Temperature Scale, to the thermodynamic scale is explained. Author.

2474. Thermo-electric thermometry. W. F. Roeser. *J. of Applied Physics*, **11**, *pp.* 388–407, *June*, 1940.—The fundamental laws and theories of thermo-electric phenomena and their historical development as well as the application of these phenomena to the measurement of temperature are discussed in considerable detail. Thermo-electric thermometry, with particular regard to types of thermocouples, protection of thermocouples, fundamental considerations in temperature measurements, etc., are treated primarily from the practical standpoint. Author.

***2475. New 2-colour optical pyrometer.** H. W. Russell, C. F. Lucks and L. G. Turnbull. *J.O.S.A.*, **30**, *pp.* 248–250, *June*, 1940.—The instrument consists essentially of 2 pyrometers, one operating in the red and the other in the green; these consist of photo-electric cells and appropriate light filters and are connected to a circuit which indicates a quantity proportional to the ratio of the intensity of the 2 radiations. This circuit is a Wheatstone bridge arrangement connected to a valve circuit using a visual tuning tube as a null detector. A similar, but less portable, circuit using a galvanometer is also described. A calibration curve of log (R_G/R_R) against temperature is given; it is a straight line. The apparatus works well on sources having temperatures over 1000°C. The readings of the pyrometer are subject to errors of about 10°C. G. G.

2476. Optical pyrometry. W. E. Forsythe. *J. of Applied Physics*, **11**, *pp.* 408–420, *June*, 1940.—A general review.

2477. Magnetic cooling, the production and measurement of temperatures below 1°K. C. F. Squire. *J. of Applied Physics*, **11**, *pp.* 232–240, *April*, 1940.—A general review.

See also Abstract 2469.

THERMOCHEMISTRY.

2478. Heats of combustion of urea and guanidine carbonate and their standard free energies of formation. H. M. Huffman. *Am. Chem. Soc., J.*, **62**, *pp.* 1009–1011, *May*, 1940.—The isothermal heats of combustion of urea and guanidine carbonate at 25° were determined as 151·44 ± 0·4 and 461·07 ± 0·13 k.cal. per mole, respectively. The calculated free energies are − 47·21 ± 0·18 and − 144·34 ± 0·45 k.cal., respectively. A comparison of the free energy of urea from equilibrium data and third law data is made. [See Abstract 2942 (1938).] N. M. B.

***2479. Determination of the heat evolved in reactions at high temperatures and pressures.** A. Léopold. *Comptes Rendus*, **210,** *pp.* 672–674, *May* 6, 1940.—The method previously described (*Annales de l'Office national des Combustibles liquides*, **4,** *pp.* 642–657, 1938) for the measurement of the total heat evolved in hydrogenation reactions at constant volume and at high temperatures and pressures has been further developed and the apparatus improved. A full description of the various details is now given and includes illustrative diagrams for the hydrogenation of tetraline in a 5l. autoclave. H. H. Ho.

2480. Heat of formation of calcium aluminate. W. A. Roth and U. Wolf. *Zeits. f. Elektrochem.*, **46,** *pp.* 232–233, *March*, 1940.—The heat of formation of calcium aluminate $5CaO,3Al_2O_3$ out of CaO and carborundum was determined by the solution method and found to be equal to − 11·1 k.cal. at 20° C. The heat of formation of $3CaO,Al_2O_3$ using modern values was redetermined as − 3·9 k.cal. instead of + 20·7 k.cal., and the heat of crystallization of $5CaO,3Al_2O_3$ was found to be ± 34·7 k.cal. G. G.

2481. Heats of formation of V_2O_3, V_2O_4 and V_2O_5. H. Siemonsen and H. Ulich. *Zeits. f. Elektrochem.*, **46,** *pp.* 141–145, *March*, 1940.—The purest Va metal obtainable, containing 99·6% V, was used. Thermochemical data were obtained in the following experiments—the reduction of V_2O_5 to V_2O_4; the oxidation of V_2O_3 to V_2O_5; and the burning of metallic V. The following results were deduced for the heats of formation from metallic V: V_2O_3, − 296 ± 2 k.cal.; V_2O_4, − 342 ± 2 k.cal.; V_2O_5, − 373 ± 2 k.cal. G. G.

2482. The thermal reaction between hydrogen and oxygen. Part I. Comparison of experiments and theory. O. Oldenberg and H. S. Sommers, Jr. *J. Chem. Phys.*, **8,** *pp.* 468–476, *June*, 1940.—The present theory of the slow thermal reaction between hydrogen and oxygen, while satisfactorily describing the existence of the various explosion limits, fails to describe the following features: the sudden transition from the slowest reaction to the explosion (" second explosion limit "), and some effects of the vessel size and of a KCl film on the rate and the second explosion limit. Conclusions regarding the theory are discussed. Authors.

See also Abstracts 2457, 2460.

THERMODYNAMICS.

2483. The derivation of the equilibrium conditions in physical chemistry on the basis of the work principle. J. N. Brønsted. *J. Phys. Chem.*, **44,** *pp.* 699–712, *June*, 1940.—The assumption of traditional thermodynamics that heat can be produced or consumed in reversible processes is caused by an incomplete analysis of the basic phenomena associated with such processes. The fundamental law for all reversible processes is the work principle $\Sigma\delta A = 0$, indicating that the total work expended or lost in a reversible process is zero. Since the reversible process is a change through states of equilibrium, the work principle, valid for such processes, can be made the basis for the deduction of all expressions of physicochemical equilibria. The differential transport of a fraction of a homogeneous system from a certain state into another deviating infinitesimally from the first is a reversible process. The work associated with it is therefore zero. This is called the *work theorem for infinitesimally diverging systems*. On the basis thus given a detailed deduction of some important equilibrium equations in physical chemistry has been presented. AUTHOR.

2484. Brønsted's criticism of classical thermodynamics. F. H. MacDougall. *J. Phys. Chem.*, **44**, *pp.* 713–715, *June*, 1940.—A note on the preceding article.

2485. The explanation of a rule for critical temperatures. J. Corner. *Faraday Soc., Trans.*, **36**, *pp.* 781–784, *July*, 1940.—It is shown that the theory of liquids developed by Lennard-Jones and Devonshire explains the form of Watson's rule for critical temperatures, and also gives the correct form of the variation of the ratio of the critical temperature to the boiling-point, for the simple " permanent gases " and the normal paraffins. AUTHOR.

2486. Thermodynamics of *n*-heptane and 2,2,4-trimethylpentane. K. S. Pitzer. *Am. Chem. Soc., J.*, **62**, *pp.* 1224–1227, *May*, 1940.—The thermal behaviour of (A) *n*-heptane and (B) 2,2,4-trimethylpentane was investigated from 15° to 423°K., and heat capacities in this range are given. The following heats of fusion and vaporization were obtained: (A) 3 355·8 ± 4 and 7 660 ± 20; (B) 2 201·6 ± 2 and 7 410 ± 20 cal. per mole. The entropies calculated for the liquid at 298·1° K. and for the gas at the boiling point are, respectively: (A) 78·60 ± 0·2 and 111·77 ± 0·3 and (B) 78·40 ± 0·2 and 112·05 ± 0·3. N. M. B.

2487. The dependence of thermodynamic functions on the mass of the system. E. L. Hill. *Am. J. Phys.*, **8**, *pp.* 168–170, *June*, 1940.—It is generally assumed self-evident that, for given values of the intensive variables, the extensive variables are proportional to the amount of substance present, but the author points out that an understanding of the nature of the problem requires the application of statistical mechanics. A study is made of the case of an ideal gas of structureless mass particles, wherein it is shown that in principle the above hypothesis is not correct even for this simple system. However, on calculation it is found that deviations are of the nature of quantum effects and are usually negligible, so that for homogeneous phases the assumption underlying the thermodynamic treatment is generally valid. H. H. Ho.

2488. Thermodynamic properties of hexyl alcohols. Part IV. 3-methylpentanol-1 and 2-methylpentanol-5. F. Hovorka, H. P. Lankelma, and I. Schneider. *Am. Chem. Soc., J.*, **62**, *pp.* 1096–1098, *May*, 1940.—Preparation and purification of the alcohols are described. Data for surface tension, viscosity, density, and vapour pressure, for the temperature range 5° to the boiling point, and for refractive index for 15° to 45°, are tabulated. Heat of vaporization, boiling point and the constants of Rankine's equation, are determined from the vapour pressure data. The calculated vapour pressures agree well with experiment. Viscosity values calculated from the Raman-Andrade equation give poor agreement with experiment. The two alcohols give almost the same values for Andrade's constants and for degrees of association as obtained for hexanol-1. The parachor, Eötvös constant and critical constants, are calculated from surface tension data. [See Abstract 825 (1940).] N. M. B.

2489. Entropy of vaporization and restricted molecular rotation in liquids. R. S. Halford. *J. Chem. Phys.*, **8**, *pp.* 496–499, *June*, 1940.—Deviations among entropies of vaporization to constant vapour volume are attributed to restricted rotation of molecules in the liquid. An arbitrary measure of the amount of restriction is defined and the deviations are shown to exhibit a remarkable regularity when compared on this basis. Deviations due to perturbation of vibrations in the liquid must either parallel those due to restricted rotation or be quite small. AUTHOR.

See also Abstracts 2345, 2346; 2491.

VAPORIZATION AND CONDENSATION.

2490. Vapour pressures of Ni and of NiO. H. L. JOHNSTON AND A. L. MARSHALL. *Am. Chem. Soc., J.*, **62,** *pp.* 1382–1390, *June,* 1940.—Rates of evaporation of solid Ni have been measured between approximately 1300 and 1600°K., and the data employed to compute vapour pressures of the metal. The results obtained are in good agreement with thermodynamic requirements for the free energy of evaporation and yield 101·141 (± 150) cal. for the heat of sublimation at 0 abs. The data yield an accurate vapour pressure equation for solid Ni. Vapour pressures of NiO have also been determined for the temperature interval 1440 to 1566° K.

2491. Correlating vapour pressure and latent heat data. D. F. OTHMER. *Indust. and Engin. Chem.*, **32,** *pp.* 841–856, *June,* 1940.—Vapour pressures of liquids, of solids, of solutions having a non-volatile constituent, of solutions having 2 or more volatile constituents, of hydrates losing water by efflorescence and of other materials undergoing decomposition, give straight lines when plotted on logarithmic paper against values of the vapour pressures at corresponding temperatures of a reference substance. The slope of the line is equal to the ratio of the latent or other total heat quantity involved in the evolution of the vapour to the latent heat of the reference substance. This indicates the validity of the equation, $\log P = L/L' \log P' + C$, where P and P' are pressures, L and L' molal latent heats, respectively, of the 2 compounds always taken at the same temperatures and C is a constant. Plots are made to illustrate the utility of this relation with various materials in checking and correlating vapour pressure data, and it gives lines more nearly straight than are obtained by any other method of plotting which has been suggested. Latent heats have been evaluated and checked ; and heats of fusion, of hydration, of dissociation, of dilution or solution, of chemical reaction, etc., are shown to be related to the method and may be calculated. Freezing points of salt solutions, enthalpy charts, steam distillation relations, composition of vapours from boiling binary solutions, constant-boiling mixtures and other phenomena relating to the disengaging of vapours from a condensed phase, may also be studied and evaluated by this method. A comprehensive relation is developed which includes all of the other general methods used for graphic vapour-pressure representation. Some other useful forms of equations for similar calculations are suggested. AUTHOR.

***2492. Sensitive static vapour pressure apparatus.** R. C. CHANDLER. *J. Phys. Chem.*, **44,** *pp.* 574–583, *May,* 1940.—A differential manometer suitable for measuring changes in vapour pressure down to 10^{-4} mm. is described, and representative data obtained with KCl and gelatine solutions are given. A. J. M.

See also Abstract 2489.

ACOUSTICS.

***2493. Vibration source of variable frequency for Melde's experiment.** P. I. WOLD AND F. J. STUDER. *Am. J. Phys.*, **8**, *pp.* 165–167, *June*, 1940.—The scope of Melde's experiment can be much extended, both for demonstration purposes and for quantitative experiments, by using a properly designed eccentric on a variable-speed rotor as a source of vibration. By this arrangement it is possible to vary the frequency continuously and measure it directly, rendering possible the study of all the relations between frequency, force, wavelength and mass, of a stretched string. A table of typical data is included, together with photographs of demonstrations. H. H. Ho.

2494. Propagation of sound in a homogeneous atmosphere. Y. ROCARD. *Rev. sci., Paris*, **78**, *pp.* 209–211, *April*, 1940.—The author deduces an expression for compression in terms of altitude from which it follows that (1) there is a frequency below which the whole atmosphere vibrates vertically in phase; (2) the amplitude varies exponentially with altitude. It appears that with increasing altitude the amplitude of sonic density variation diminishes absolutely but increases relatively. D. R. H.

2495. Recent work in experimental phonetics. E. G. RICHARDSON. *Nature*, **145**, *pp.* 841–843, *June* 1, 1940.—Discussion of a number of records of the vowel *a* by a male voice at different frequencies. There is not only a change in the fundamental pitch, but also, accompanying each fresh setting of the vocal cords, the intrusion of sufficient harmonics of the fundamental to disguise in the spectrum the fact that the same vowel is being enunciated throughout the set. Changes in the spectrum also occur when the intensity is altered at constant pitch. Other variations in the waveform of a vowel may be introduced by the consonant which precedes or follows it. The existence of a formant proper to each vowel is the cause of the variation of the wave pattern with pitch in the given records. The study of phonetics involves the activities of the philologist, physicist and physiologist, and the taking of X-ray photographs of the larynx and of high-speed cinematograph pictures of the motion of the vocal cords as seen through the laryngoscope. G. E. A.

See also Abstracts 2430, 2431.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

2496. Electric leakage in an enclosed volume of air. B. WALTER. *Ann. d. Physik*, **37**, 4, *pp.* 326–332, *April*, 1940.—A large brass chamber was used in connection with a Wulf electrometer for determining the conductivity of an enclosed volume of air. The conductivity does not change gradually [see Abstract 1918 (1901)], but remains constant over a period of days. The author ascribes Elster and Geitel's results to the fact that they used a glass container, on which electrical charges collect easily. L. K.

***2497. Cathode sputtering in a magnetic field.** F. M. PENNING AND J. H. A. MOUBIS. *K. Ned. Akad. Wet., Proc.*, **43**, 1, *pp.* 41–56, 1940. *In English*.—After a brief survey of the experiments on cathode sputtering, an apparatus is described for cathode sputtering in a magnetic field which is applied in such a way that the electron paths are increased, thus augmenting the amount of ionization. This apparatus allows sputtering to be carried out in a pressure region in which the sputtering coefficient may be directly determined and also allows the variables current density, voltage and gas density, to be varied independently of each other. The sputtering coefficients of Al, Cu, Ni and Ag in Ar and of Ni and Ag in H_2 are measured and the sputtering coefficients calculated; the latter, in agreement with the conclusions of Güntherschulze and Meyer, are of the order of 1% or less. H. J. H. S.

2498. The polarity of the ions in the positive column of the glow discharge in N and O. E. Wehnelt and H. Lämmerhirt. *Zeits. f. techn. Physik,* **21,** 4, *pp.* 88–93, 1940.—Two methods are described by means of which the polarity of the ions at various positions in the positive column of the glow discharge in N and O have been determined. The first method employed a wire probe, while the second used a collecting electrode in the form of a circular disc. It was found that in the luminous portion of the discharge positive and negative ions existed, while in the dark portion none or, in comparison with the number in the bright region, only a very few were present. G. O. B.

2499. Measurements of discharge characteristics of Geiger-Müller counters. W. E. Ramsey. *Phys. Rev.,* **57,** *pp.* 1022–1029, *June* 1, 1940.—An experimental method is presented for determining directly the V/t relationship (for $t = 2 \times 10^{-7}$ to 1×10^{-4} sec. and $V = 20$ to 350) of a counter wire from the initiation of the discharge to the attainment of the maximum negative potential of the wire. The relation $E = -(Q/c)\log_{10}(t/t_0 + 1)$ satisfactorily represents the observations, where E = potential of the wire, Q = a function of cylinder voltage, and t_0 = const. for a given counter. Hence the current in the counter is inversely proportional to the time. Modifications for the case where conditions are such that the counter "overshoots" (the voltage pulse E_{max} from the counter exceeds in magnitude the difference between starting potential and cylinder potential) are examined. Discharge characteristics were measured for a series of pressures of an A-O_2 mixture and results satisfy the logarithmic relation. An A-alcohol or self-quenching counter has characteristics of the same form. N. M. B.

2500. Discharge mechanism of Geiger-Müller counters. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.,* **57,** *pp.* 1030–1040, *June* 1, 1940.—The measurements of Ramsey are interpreted on the basis of the inductive action of the positive ion space charge moving across the counter, and this action, with the hypothesis that the positive ions may eject electrons when they reach the cathode, explains both the fast and slow types of breakdown of counters. Hence the quenching of a counter discharge and the necessary conditions for the maintenance of a steady discharge are simply explained, and it is predicted and verified experimentally that a counter can be operated even when the potential considerably exceeds that required for a continuous discharge, provided that the capacitance of the counter wire is sufficiently reduced. A simple indirect method is described for measuring the breakdown characteristics of a counter, and this gives results in good agreement with the direct determinations. N. M. B.

CONDUCTION IN SOLIDS AND LIQUIDS.

***2501. Electrodeless measurement of resistance of metals and alloys.** G. GRUBE AND H. SPEIDEL. *Zeits. f. Elektrochem.*, **46,** *pp.* 233–242, *March,* 1940.—The metal specimen is heated to the desired temperature in a crucible of ceramic material and measurements are made in both an electric and a magnetic alternating field. Full details of the apparatus are given. Results are given of the specific resistance at various temperatures of the α, β, γ and δ forms of Mn. G. G.

See also Abstract

1506B. Recording of current pulses by slow galvanometers. F. T. Rogers.

DIELECTRICS AND CAPACITANCE.

2502. The dielectric properties of the system gelatine-water. Part II. H. FRICKE AND E. PARKER. *J. Phys. Chem.*, **44,** *pp.* 716–726, *June,* 1940.—In continuation of earlier work [see Abstract 2991 (1939)] dielectric constant and electric conductance measurements were carried out on the system gelatine-water in the range of high gelatine concentrations (47 to 100% gelatine) between 2 and 1024 kc./s. The dielectric constant of dried gelatine is low and nearly independent of frequency (= 2·68 at 512 kc./s.). The dispersion in dielectric constant and in conductance varies with frequency according to a power of the frequency law, as found earlier for systems of lower gelatine concentration. The change in polarizability resulting from heat treatment or from a change in *p*H runs parallel to the change in internal forces as represented by the change in volume. Anomalous dispersion, similar in character to that in gelatine, is found generally in dispersed systems containing water as the dispersion medium.

2503. Magnitude of the solvent effect in dipole-moment measurement. Part II. Resolution of the solvent effect into its contributory factors. F. R. GOSS. *Chem. Soc., J., pp.* 752–758, *June,* 1940.—[See Abstract 831 (1938).] Analysis of the dielectric polarization of certain binary mixtures of polar with non-polar liquids shows that the solvent effect can be resolved into contributions depending on the anisotropy of the electrical field which varies with the shape of non-spherical molecules, and on induction effects related to the dielectric constant of the liquids and arising both from the reaction field and from permanent dipoles. A linear relationship has been established between the field anisotropy contribution and the ratio of the axes of the polarization ellipsoid which defines the electrical dimensions of the molecule. By assuming, in the usual manner, an approximate and average value for the atom polarization, it is possible by a series of formulae to rectify the observed polarization in the liquid state for each, in turn, of the 3 contributions to the solvent effect, and so to obtain a corrected value for the polarization of the liquid. This, in conjunction with the value for the corresponding vapour obtained by making similar approximations concerning the atom polarization, yields by a suitable relation the atom and the orientation polarizations, together with the dipole moment, free from any error due to the above approximation. AUTHOR.

2504. Calculation of dipole moments from rates of nitration of substituted benzenes and its significance for organic chemistry. T. RI AND H. EYRING. *J. Chem. Phys.*, **8,** *pp.* 433–443, *June,* 1940.—From a set of assumptions, which seem reasonable *a priori*, the authors calculate the charge distributions in the molecules of mono-substituted benzenes and the dipole moments of the latter from reaction rate data alone. These coincide with the observed moments. From the dipole moments of aromatic and aliphatic compounds the ortho-, meta- and para-percentages during nitration were calculated. These also accord satisfactorily with the experimental values. It is concluded that these facts give a quantitative basis to the usual explanation about the orienting power of substituents of benzene. The nitration of benzene is an ionic reaction : the nitrating agent $X \cdot NO_2$ dissociates into X^- and NO_2^+ in the activated complex, and the latter ion interacts with the reacting carbon. The activation free energy is reduced by the amount of the electrostatic interaction, i.e. $4 \cdot 80 \times 10^{-10} \epsilon_y/(rD)$. Here ϵ_y is the charge on the reacting carbon, r the distance between NO_2^+ and the reacting carbon in the activated complex, D the dielectric constant of the medium between NO_2^+ and the reacting carbon. The authors find that $r = 1 \cdot 6$ Å and $D = 1$ approximately, independent of the nature of the reacting media. The consequences of this theory are outlined. This interpretation of reaction rates provides a method of calculating the atomic charges in the molecules as distinguished from the usual dielectric measurements which lead only to dipole moments. AUTHORS.

2505. The dipole moments and structures of the esters of some fatty and some inorganic acids. G. L. LEWIS AND C. P. SMYTH. *Am. Chem. Soc., J.*, **62,** *pp.* 1529–1533, *June*, 1940.—The dielectric constants and densities of solutions of ethyl undecylate, palmitate and stearate in heptane, of *n*-propyl, *i*-butyl and *s*-butyl borate in benzene, and of triphenyl phosphite, phosphate and thiophosphate in benzene, have been measured at 25° and used to calculate the dipole moments of the molecules of the solutes. The small variation of polarization with concentration shows the intermolecular action to be very small in the 3 trialkyl borates and in triphenyl phosphite and to decrease with increasing molecular size in the long-chain fatty acid esters. The small intermolecular action is due to effective screening of the dipoles from one another by the hydrocarbon groups, while the large intermolecular action in the phosphate and thiophosphate is due to the presence of an imperfectly screened semipolar bond.

2506. Dipole moments and structures of certain compounds of S, Se and P. C. P. SMYTH, G. L. LEWIS, A. J. GROSSMAN, AND F. B. JENNINGS. *Am. Chem. Soc., J.*, **62,** *pp.* 1219–1223, *May*, 1940.—The dielectric constants and densities of solutions of H_2S_2, S_2Cl_2, Se_2Cl_2, $SeOCl_2$, $POCl_3$, and $PSCl_3$ in C_6H_6 and heptane were measured and used to calculate the dipole moments of the molecules of the solutes. The H_2S_2 moment may be explained by an extended structure H–S–S–H, or best if the substance contains also a small proportion of branched molecules H_2S-S. The S_2Cl_2 and Se_2Cl_2 moments may be explained with difficulty by extended structures Cl-S-S-Cl and Cl-Se-Se-Cl, but correspond better to branched structures, S-SCl_2 and Se-$SeCl_2$ in the form of an irregular tetrahedron like that of $SOCl_2$ and $SeOCl_2$, or to a mixture of the extended and the branched structures. The value $3 \cdot 0$ is calculated for the moment of the Se-O bond in $SeOCl_2$ which has more polar character than the S-O bond in thionyl chloride. The moments of $POCl_3$ and $PSCl_3$ were used to calculate the values $3 \cdot 5$ and $2 \cdot 5$ for the moments of the semipolar bonds $P^+ - O^-$ and $P^+ - S^-$, the latter of which is lowered more than the former by induction. [See Abstract 229 (1940).] N. M. B.

2507. Resonance in micro-wave transmission lines. H. R. L. LAMONT. *Phil. Mag.*, **29,** *pp.* 521–540, *June*, 1940.—A method due to R. King [Abstract 3229 (1937)] measures dielectric constants by surrounding part of the length of a Lecher wire system by the dielectric, and measuring the change in resonant length of the wires. In the first part the theory of the method is given, showing that the decrease in resonant length depends on the position of the dielectric slab along the wires. Amplitudes of the stationary waves in the zones in the dielectric and on either side of it, are in general different. Diagrams are shown illustrating the effects. In the second part the theory is extended to the passage of micro-waves along a hollow tube wave guide. Similar equations hold, and when a portion of the tube is filled with dielectric, a similar change in resonant length results. The theories of both the *E* and *H* waves are studied. Diagrammatic representation is more difficult for the wave-guide theory, but some of the features are roughly illustrated. J. P. A.

ELECTROCHEMISTRY.

2508. The system magnesium sulphate, cadmium sulphate and water at 25° and 40°. W. C. Vosburgh, V. H. Dibeler, H. C. Parks and W. J. Miller. *Am. Chem. Soc., J.*, **62,** *pp.* 1472–1477, *June,* 1940.—In a previous study of modified Weston cells [Abstract 4665 (1939)] some difficulty was experienced in the preparation of a double salt of magnesium and cadmium sulphates. It is now shown that the double salt, $MgSO_4 \cdot CdSO_4 \cdot 14H_2O$, stated to have been prepared by Schiff in 1857, can exist in equilibrium with saturated solutions at 40° C. but not at 25° C. A transition point for the system was found at about 30·2° C. H. H. Ho.

2509. Etching of Pt metals and alloys by a.c. electrolysis. E. Raub and G. Buss. *Zeits. f. Elektrochem.*, **46,** *pp.* 195–202, *March,* 1940.—Experiments are described on specimens of Pt, Ir, Rh, Pd, and on alloys of Pt-Ir, Pt-Rh, Pt-Ru and Pt-Os, which were in a state of no previous recrystallization and also after various forms of heat treatment and working. Many microphotographs showing the results obtained are reproduced. G. G.

2510. Electrolytic preparation of Fe. W. Geller. *Zeits. f. Elektrochem.*, **46,** *pp.* 277–278, *April,* 1940.—The investigations of F. Körber and W. Oelsen [*Mitt. Kais. Wilh. Inst., Eisenforsch.* **15,** *pp.* 293–294, 1933] on the reactions between molten Fe and silicic acid show that silicates in the molten state are dissociated ionically, the ions being Fe^{++}, Mn^{++}, SiO_3^{--} and SiO_4^{----}. An attempt was made to electrolyse a silicate melt made out of pure magnetite and sand, heated to about 1350° C. using a current of 75–80 A. The crucible holding the melt was the cathode and a rod of armco Fe the anode. After 4 hours deposits were found to have formed at both the anode and cathode. That at the cathode consisted of 62·92% total Fe of which 31·72% was in the metallic state. G. G.

2511. Construction and potential of glass electrode chains, calibration of *p*H scales. L. Kratz. *Zeits. f. Elektrochem.*, **46,** *pp.* 253–259, *April,* 1940.—The cause for the production of a membrane potential in the glass electrode is related to the tendency of the H^+ to pass through it from the acid to the alkaline side. This explanation is developed and various equations obtained which are used in determining the sign of the potential produced at the membrane. Chains of electrodes are considered. The various desirable factors in constructing such chains are discussed. The use of glass electrodes in conjunction with a valve voltmeter and its calibration in terms of *p*H values is discussed and a calibration curve for such an apparatus is reproduced. G. G.

2512. Absolute reaction rates and the photovoltaic effect. E. Adler. *J. Chem. Phys.*, **8,** *pp.* 500–501, *June,* 1940.—Applying the theory of absolute reaction rates, the dependence of the photo e.m.f. on the intensity of the illumination is calculated. The results are applied to 2 limiting cases (1) where the active electrode is an oxide, sulphide or halide of Cu or Ag, (2) at very low intensities or for pure metal electrodes. Agreement is obtained with experiment in both cases. F. C. C.

2513. Action of magnetism on electrolytic solutions. G. Destriau. *Comptes Rendus*, **210**, *pp*. 697–699, *May* 15, 1940.—When an electrolytic solution is placed in a non-uniform magnetic field its normally horizontal surface shows a difference of level. If this difference of level is prevented mechanically there is a p.d. between 2 points in that solution which, if unrestrained, would be at different levels. C. A. S.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2514. Photomagnetic disintegration and magnetic moment of the deuteron in the meson theory. S. T. Ma. *Cambridge Phil. Soc., Proc.*, **36**, *pp*. 351–362, *July*, 1940.—The interaction between an external electromagnetic field and a nuclear system can be expressed in terms of the multipole moments. The electric quadripole and the magnetic dipole moments of the deuteron have been calculated, taking into account the exchange forces as given by the meson theory. The cross-section of the photomagnetic effect of the deuteron has been calculated. Author.

2515. Resonance scattering of α-particles. M. E. Rose. *Phys. Rev.*, **57**, *pp*. 958–965, *June* 1, 1940.—The elastic scattering of α-particles by nuclei of zero spin is considered from the point of view of the many-body theory. Procedures for determining resonance energies and the assignments of angular momenta are discussed and criticized; they do not take into account the straggling of the incident beam and, in addition, in the determination of resonance energies and the widths of resonance levels the interference scattering should be considered. An alternative method is suggested for obtaining the angular momenta directly from measurements of the angular distribution of the scattering at fixed energies, and this is essentially independent of the straggling of the α-particles and of the details of the theory. A procedure for a more accurate determination of the energies and widths of resonance levels is given, the straggling being eliminated, and the resonance energy and width depend only on readily measurable quantities. N. M. B.

2516. The calculations of processes involving mesons by matrix methods. A. H. Wilson. *Cambridge Phil. Soc., Proc.*, **36**, *pp*. 363–380, *July*, 1940.—In a previous paper a new method, based on Kemmer's β-formalism, of calculating meson processes was given for the case in which the meson interacts with an electromagnetic field. This method is now extended to the nuclear interaction, so that the whole of the meson theory can be given either in tensor or in matrix form, the former being preferable when the wave aspect of the meson is important and the latter when the particle aspect is dominant. As examples of the matrix method, derivations are given of the cross-sections for the nuclear scattering of mesons and for the production of mesons from nuclei by photons. It is pointed out that the usual non-relativistic theory of the nuclear interaction is inadequate even for very small velocities. Author.

2517. Protons from the transmutation of boron by deuterons. E. Pollard, W. L. Davidson, Jr. and H. L. Schultz. *Phys. Rev.*, **57**, *pp*. 1117–1121, *June* 15, 1940.—The technique of studying proton groups produced by bombarding elements with deuterons from a cyclotron is described. Applied to the bombardment of boron by 3·1-eMV deuterons the method shows the presence of 4 groups, 3 of which agree with those found by Cockcroft and Lewis while the 4th, a very prominent group of Q value + 2·39 eMV, is new and is ascribed to a 3rd excited state of B^{11}.

AUTHORS.

2518. Collisions of α-particles with carbon nuclei. G. A. WRENSHALL. *Phys. Rev.*, **57**, *pp.* 1095–1101, *June* 15, 1940.—More than 750 000 thorium (C + C′) α-particle cloud tracks have been photographed with a stereoscopic camera using a cloud chamber filled in one series with methyl-chloride and helium, and in another with acetylene and helium. For each series a range/velocity curve for carbon has been constructed by plotting the measured ranges, reduced to standard air values, against the calculated velocities for a total of 55 selected α-particle-carbon collisions. These curves are used for testing the validity of the method of reducing the ranges of heavy recoil nuclei in any gas to standard air values. Partial validity of the method has been observed in the present instance. An empirical relationship between the total mean straggling (in range), the atomic numbers of the atoms comprising the absorbing medium and the atomic number of the recoil nucleus, is presented. A brief analysis of the effectiveness of certain errors on the range/velocity results is given.

AUTHOR.

2519. Heavy electron pair theory of nuclear forces. R. E. MARSHAK. *Phys. Rev.*, **57**, *pp.* 1101–1106, *June* 15, 1940.—The heavy electrons are assumed to be identical with electrons in every respect (" hole " theory, Fermi statistics, etc.) except that their rest mass is taken equal to the cosmic-ray meson mass. A tensor interaction between the nuclear particles and the heavy electron pair field can alone account for the spin dependence of the nuclear forces and the positive quadrupole moment of the deuteron. It is interesting that a pseudo-vector interaction gives both the wrong sign of the quadrupole moment and too much repulsion. The potential function between 2 nuclear particles behaves at large distances, r, as $e^{-2kr}/r^{2.5}$, $k = \mu c/h$, so that the range is effectively $\frac{1}{2}$ the single meson range and is directly connected with the rest mass of the heavy electron pair field (in contrast to the Gamow-Teller pair theory). At small r the potential depends on $1/r^5$ so that one has to cut off in the same way as in the original electron-neutrino theory. The advantage of the heavy electron pair theory over a neutral meson theory is that it deals with particles which can be identified with the cosmic-ray mesons. AUTHOR.

2520. Secondary emission factors of insulators. H. SALOW. *Zeits. f. techn. Physik*, **21**, 1, *pp.* 8–15, 1940.—The known results on the charging of insulators on bombardment with electrons are summarized, and the agreement between the potential obtained on an insulator and the free potential of a similarly irradiated insulated metal plate is shown. The free potential found on an insulated metal plate on bombardment of it by 2 electron beams is measured. For one beam the secondary emission factor is smaller than unity while for the other it is larger. A process is fully described by which the secondary emission factors of insulators can be measured. This process can also be used for insulated metal plates. The dependence of the secondary emission factors on the primary electron velocity (in volts) is given for mica, quartz and glass. The secondary emission characteristics of insulators are found to be similar to those of metals, with the maximum values higher than those of pure metals. Purity and previous history of the surfaces are shown to be of great importance both for the magnitude and characteristics of the secondary emission factors. G. O. B.

2521. Stereo-super-microscopy with the universal electron microscope. M. v. ARDENNE. *Naturwiss.*, **28**, *pp.* 248–252, *April* 19, 1940.—For a resolving power of 3×10^{-6} mm. and an aperture of the objective of 3×10^{-3} a sharp image of an object can be obtained if the object has an extension of 2μ in the direction of the optical axis. Two consecutive photographs are taken of the object in 2 positions; the angle between these positions can be varied from 0 to ± 6° from outside. Some stereoscopic photographs are reproduced. L. K.

***2522. The electron shadow microscope.** H. BOERSCH. *Zeits. f. techn. Physik*, **20**, 12, *pp.* 346–350, 1939, and **21**, 3, *p.* 75, 1940.—By using the smallest possible electron source to irradiate an object, a shadow picture is obtained whose size depends on the spreading out of the beam. The electron source was produced as a reduced copy of a cathode with an electron lens of short focal length and high potential, the focal length being independent of fluctuations of the high potential. By using 2 lenses in the production of the electron source spreading was so reduced that the bending of the beam at the object put a limit to the resolution. With this arrangement a resolution of 10^{-6} cm. was obtained. The exposure time is slightly shorter than that of the normal electron microscope. G. O. B.

***2523. Investigation of metallic oxide smokes with electron microscope.** M. v. ARDENNE AND D. BEISCHER. *Zeits. f. Elektrochem.*, **46**, *pp.* 270–277, *April*, 1940.—In many industrial processes metals are obtained in the form of smokes. Large particles down to about $0{\cdot}2\mu$ diameter can be investigated with the microscope and still smaller particles with the ultramicroscope, which, however, will not give all the data that might be desired. For this reason it was decided to design an electron-beam microscope for such investigations and an apparatus of this type with a resolving power of 3×10^{-6} mm. is described. Results obtained with the apparatus are described and photographs reproduced, showing the change from MgO to $MgCO_3$, cubic crystals in a smoke of CdO from an arc, the fine structure of a smoke of $Zn(OH)_2$, a lead oxide smoke from an arc lamp, as well as iron oxide aerosols. The apparatus can also be used to produce stereoscopic photographs. The mean particle size of a CdO smoke was found to be 120 Å whilst an X-ray investigation of the same smoke gave a particle size of about 500 Å. G. G.

2524. Cathode-ray oscillograph as a means of demonstrating elliptically polarized light. L. R. STEINHARDT. *J.O.S.A.*, **30**, *pp.* 226–228, *May*, 1940.—The author describes simple methods for obtaining 2 alternating voltages of independently variable phase difference and amplitudes for application to the vertical and horizontal deflecting plates of the oscillograph. W. S. S.

See also Abstracts 2333, 2454, and

1539 B. Nuclear fission. K. K. Darrow.
1582 B. Quantized emission. T. V. Ionescu.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2525. The influence of magnetization on the Benedicks homogeneous thermo-electric effect. W. W. MO, Y. K. HSÜ AND W. BAND. *Cambridge Phil. Soc., Proc.*, **36**, *pp.* 381–386, *July*, 1940.—The complete hysteresis loops of the Benedicks e.m.f. under magnetizing fields up to 300 gauss are mapped. Their forms are complex and they are different from what might have been expected from an examination of the initial-rise curves. The loops have been analysed into normal and anomalous components. The former fit reasonably with those from data on the Thomson e.m.f. hysteresis loops. The anomalous loops require explanation, suggested in terms of skin magnetization. [See Abstract 870 (1936).] AUTHORS.

MAGNETISM AND ELECTROMAGNETISM.

2526. Optical and magnetic properties of magnetite suspensions. Surface magnetization in ferromagnetic crystals. L. W. MCKEEHAN. *Phys. Rev.*, **57,** *pp.* 1177–1178, *June* 15, 1940.—A magneto-optic effect discovered by Grove is suggested as explaining, in part at least, peculiarities of ferromagnetic colloid patterns on ferromagnetic crystal surfaces. AUTHOR.

See also Abstract 2512.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***2527. Serial planeography (serioscopy) and serial planigraphy.** J. KAUFMAN AND H. KOSTER. *Radiology*, **34,** *pp.* 626–629, *May*, 1940.—An analysis of the method introduced by the authors in 1936 [Abstract 4719 (1937)]. Planeography is a procedure by which 2 or more radiograph films of all the object planes may be delineated and localization, mensuration, plane reconstruction, are all made possible. The limitations of serial planeography (serioscopy) [Abstract 565 (1940)] are critically analysed. It is claimed that planeography accomplishes the following: (1) radiographic films (planeograms) of all the object planes can be demonstrated, (2) the depth of the object planes so demonstrated may be determined by reference to a specially constructed curve, "the standard depth curve", (3) localization and mensuration are possible, (4) although planeograms do not represent the object planes themselves but are only displaced similar films of such planes, showing varying degrees of enlargement and displacement, (*a*) the object plane can be reconstructed by correcting the enlargement of the planeogram, (*b*) the object itself can be reconstructed by correcting the displacement of the planeogram. The delineation of planeograms may be accomplished by superposing 2 or more standard radiographs, and successive planeograms may be demonstrated by sliding the radiographs one upon the other. T. A. C.

***2528. Cathode rays for radiation therapy.** J. G. TRUMP, R. J. VAN DE GRAAFF AND R. W. CLOUD. *Am. J. of Roentgenology and Radium Therapy*, **43,** *pp.* 728–734, *May*, 1940.—The therapeutic action of X-rays and γ-rays is to produce secondary electrons having a biological effect against malignant tissue. An electrostatic h.v. generator enclosed in a steel tank at 10 atm. for producing cathode rays is illustrated and described [Abstracts 5009 (1937) and 655, 3351 (1939)]. The penetration of the cathode ray beam into wood is shown photographically and curves are given for the ionization produced at various depths in Pb, Cu, Al and water. It is graphically shown that, up to certain depths, greater intensity of the ionizing beam is produced below the skin than with X-rays and risk of skin damage is less. B. J. L.

2529. The irradiation of liquids. F. L. HOPWOOD. *Brit. J. of Radiology*, **13,** *pp.* 221–226, *July*, 1940.—Silvanus Thompson memorial lecture to the British Institute of Radiology.

PHOTO-ELECTRICITY.

***2530. An Einthoven string galvanometer-amplifier system for the investigation of photovoltaic effects.** W. Vanselow, G. P. Happ, J. Russell and S. E. Sheppard. *Kodak Research Lab., Comm. No.* 743. *Rev. Sci. Instruments,* **11,** *pp.* 202–203, *June,* 1940.—An apparatus adapted to the measurement of short-duration photo-potentials in photovoltaic cells is described. An Einthoven string galvanometer is used with a d.c. vacuum-tube amplifier which is of high stability and high sensitivity and in particular is so designed that the galvanometer string is at ground potential. Photovoltaic effects developed by silver : silver bromide electrodes during a small fraction of a second can be greatly amplified and recorded photographically by this equipment. Authors.

See also Abstracts 2434, 2512.

THERMIONICS.

2531. The nature of the ions emitted by heated filaments and salts. B. Toubes and G. K. Rollefson. *J. Chem. Phys.,* **8,** *pp.* 495–496, *June,* 1940.—It has been found that positive ions are emitted by filaments of W, Ta, and Mo when heated to temperatures near the melting points. Na and K ions were found in addition to those of the filament metal. When alkali halides were heated to 800–1000°C. on Pt they emitted the singly charged ions of the corresponding alkali metal. No negative ions were found and no ions were obtained from the chlorides of Ca, Mg, Sr, Ba or Zn. Authors.

THERMO-ELECTRICITY.

2532. On a proposed thermo-electric origin of the earth's magnetism. D. R. Inglis and E. Teller. *Phys. Rev.,* **57,** *pp.* 1154–1155, *June* 15, 1940.—It has been suggested that the earth's magnetism might arise from thermo-electric forces within the earth, the asymmetrical thermal distribution being due to material convection guided by Coriolis forces from the earth's rotation. The observed heat flow through the crust so limits the possible velocities and temperature differences that the Coriolis force seems to be inadequate by about a factor 10^6. Authors.

See also Abstract 2474.